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OF

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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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GENEVA, N. Y.

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LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12—14, 1889. President C. V. Riley; Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11—13, 1890. (The same officers had charge of this meeting).

Third Annual Meeting, Washington, D. C., Aug. 15—18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15—16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14—16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14—15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27—28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21—22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12—13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19—20, 1898. President Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18—19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22—23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23—24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27—28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26—27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29—31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting Philadelphia, Pa., Dec. 29—30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1—4, 1906. President, H.

Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28—29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27—28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28—29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28—29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28—29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27—29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1—3, 1913. President, W. D. Hunter; First Vice-President, T. J. Headlee; Second Vice-President, R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913—Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28—31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9—10, 1915. (Officers same as for Twenty-eighth Annual Meeting).

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27—30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28—30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917—Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26—27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President, G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

Thirty-second Annual Meeting, St. Louis, Mo., Dec. 31, 1919—Jan. 2, 1920. President, W. C. O'Kane; First Vice-President, A. G. Ruggles; Second Vice-President,

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Thirty-third Annual Meeting, Chicago, Ill., Dec. 29—31, 1920. President, Wilmon Newell; First Vice-President, H. A. Gossard; Second Vice-President, E. M. Ehrhorn; Third Vice-President, J. G. Sanders; Fourth Vice-President, F. B. Paddock; Secretary, A. F. Burgesss.

Thirty-fourth Annual Meeting, Toronto, Canada, Dec. 29—31, 1921. President, George A. Dean; First Vice-President, Arthur Gibson; Second Vice-President, E. O. Essig; Third Vice-President, A. G. Ruggles; Fourth Vice-President, H. F. Wilson; Secretary, A. F. Burgess.

Thirty-fifth Annual Meeting, Boston, Mass. Dec. 28—30, 1922. President, J. G. Sanders; First Vice-President, J. M. Swaine; Second Vice-President, A. L. Lovett; Third Vice-President, R. W. Harned; Fourth Vice-President, M. C. Tanquary; Secretary, A. F. Burgess.

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613. Smith, G. A., State Forester's Office, State House, Boston, Mass.
614. Smith, G. E., Albion, N. Y.
615. Smith, H. D., Kronenberg Building, Carlisle, Pa.
616. Smith, M. R., Agricultural College, Miss.
617. Smyth, E. G., 1300 Vermont Ave., Washington, D. C.
618. Somes, M. P., Kalispell, Mont.
619. Spangler, A. J., 509 Remington St., Fort Collins, Colo.
620. Speaker, H. J., Sandusky, Ohio.
621. Spencer, Geo. E., 27 High St., Woodbury, N. J.
622. Spencer, Geo. J., Agricultural College, Guelph, Canada.
623. Spencer, Herbert, Box 88, Norfolk, Va.
624. Spessard, L. L., 2108 R St., N. W., Washington, D. C.
625. Spooner, Charles, 1508 S. 3d St., Charleston, Ill.
626. Spuler, Anthony, Agricultural Experiment Station, Pullman, Wash.
627. Stafford, E. W., Agricultural College, Miss.
628. Stage, H. H., 700 Pine St., Pine Bluff, Ark.
629. Stahl, C. F., Citrus Experiment Station, Riverside, Calif.
630. Stiles, C. F., Box 37, Stillwater, Okla.
631. Stirling, Frank, State Plant Board, Gainesville, Fla.
632. Stirrett, Geo. M., Purdue University, Lafayette, Ind.
633. Stockwell, C. W., Entomological Laboratory, Riverton, N. J.
634. Strand, A. L., Agricultural Experiment Station, Bozeman, Mont.
635. Sturtevant, A. P., Bureau of Entomology, Washington, D. C.
636. Sullivan, K. C., Agricultural Experiment Station, Columbia, Mo.
637. Sutton, F. J., Middleport, N. Y.
638. Swain, A. F., 625 Brown Ave., Fresno, Calif.
639. Taft, L. R., East Lansing, Mich.
640. Talbert, T. J., Horticultural Building, Columbia, Mo.
641. Taylor, L. H., W. Va. University, Morgantown, W. Va.
642. Thomas, C. A., 120 S. Broad St., Kennett Sq., Chester Co., Pa.

643. Thomas, W. A., Chadbourn, N. C.
644. Thomspon, B. G., 600 26th St., Sacramento, Calif.
645. Tillery, J. L., Agricultural Experiment Station, Knoxville, Tenn.
646. Tower, D. G., Room 305, Custom House, New York, N. Y.
647. Tower, W. V., Mayaguez, P. R.
648. Trimble, F. M., Camp Hill, Cumberland Co., Pa.
649. Turner, C. F., 1940 Felix Ave., Memphis, Tenn.
650. Turner, W. B., 600 26th St., Sacramento, Calif.
651. Uichanco, L. B., College of Agriculture, Los Banos, P. I.
652. Underhill, G. W., Box 156, Chester, Pa.
653. Vance, Arlo M., Entomological Laboratory, Charlottesville, Va.
654. Van Duzee, E. P., Academy of Sciences, Golden Gate Park, San Francisco, Calif.
655. Van Leeuwen, E. R., 513 Dakota Ave., Medford, Oregon.
656. Vaughn, E. A., 404 N. Broad St., Thomasville, Ga.
657. Vickery, R. K., Box 340, Saratoga, Calif.
658. Vorhies, Chas. T., University Station, Tucson, Ariz.
659. Wadley, F. M., 126 S. Minneapolis Ave., Wichita, Kan.
660. Wakeland, C. C., University of Idaho, Boise, Idaho.
661. Walkden, H. H., 126 S. Minneapolis Ave., Wichita, Kan.
662. Wallace, F. N., State Entomologist, Indianapolis, Ind.
663. Walter, E. V., Tempe, Ariz.
664. Warren, Don. C., Valdosta, Ga.
665. Watts, H. R., Knoxville, Tenn.
666. Weed, C. M., State Normal School, Lowell, Mass.
667. Wehrle, L. P., Roberts Hall, Ithaca, N. Y.
668. Wells, R. W., Box 208, Dallas, Texas.
669. West, L. S., Roberts Hall, Ithaca, N. Y.
670. Whelan, Don B., 401 W. Grove St., Greenville, Mich.
671. Whitcomb, W. D., Box 5171 Station B, New Orleans, La.
672. Whitmarsh, R. D., Madison Ave., Wooster, Ohio.
673. Williamson, Warren, R. D. 5, Galesburg, Ill.
674. Willson, R. B., Roberts Hall, Ithaca, N. Y.
675. Winchester, H. I., Melrose Highlands, Mass.
676. Woodworth, H. E., College of Agriculture, Los Banos, P. I.
677. Wooldridge, Reginald, U. S. Bureau of Entomology, Melrose Highlands, Mass.
678. Worthley, H. N., Dept. Entomology, M. A. C., Amherst, Mass.
679. Wymore, Floyd H., Kittridge St., Berkeley, Calif.
680. Young, A. W., South Yarmouth, Mass.
681. Young, M. T., Tallulah, La.
682. Yuasa, Hachiro, Natural History Bldg, University of Illinois, Urbana, Ill.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.

Ballou, H. A., West Indian Agricultural College, St. Augustine, Trinidad, West Indies.

Berlese, Dr. Antonio, Reale Stazione di Entomologia, Agraria, Firenze, Italy.

Bordage, Edmond, Directeur de Musee, St. Denis, Reunion.
Brain, Charles K., Pretoria, South Africa.
Carpenter, Dr. George H., Royal College of Science, Dublin, Ireland.
Collinge, W. E., 55 Newhall St., Birmingham, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
DeBussy, L. P., Deli, Sumatra.
Escherisch, K., Forstliche Versuchsaustalt, Universitat, Munich, Germany.
French, Charles, Department of Agriculture, Melbourne, Australia.
Froggatt, W. W., Department of Agriculture, Sydney, New South Wales.
Fuller, Claude, Department of Agriculture, Peitermaritzburg, Natal, South Africa.
Goding, F. W., Guayaquil, Ecuador, South America.
Grasby, W. C., 6 West Australian Chambers, Perth, West Australia.
Green, E. E., Way's End, Beach Ave., Camberley, Surry, England.
Herrera, A. L., Director de Estudios, Bibliogicas, Secretaria de Agricultura y Formento, Mexico, D. F. Mexico.
Hill, Gerald F., Townsville, North Queensland.
Horvath, Dr. G., Musee Nationale Hongroise, Budapest, Hungary.
Jablonowski, Josef, Entomological Station, Budapest, Hungary.
Jack, Rupert W., Salisbury, Rhodesia, South Africa.
Johnson, Thomas H., University of Brisbane, Queensland, Australia.
Kulagin, Nikolai M., Petrovsky-Rasumovsky Academy, Petrovsko-Rasumovskoie, Moscow, Russia.
Kuwana, S. I., Imperial Agricultural Experiment Station, Yokohama, Japan.
Lea, A. M., National Museum, Adelaide, South Australia.
Lounsbury, Charles P., Department of Agriculture, Pretoria, Transvaal, South Africa.
Mally, C. W., Department of Agriculture, Cape Town, South Africa.
Marchal, Dr. Paul, 16 Rue Claude-Bernard, Paris, France.
Mokshetsky, Sigismond, Warsaw University, Warsaw, Poland.
Mussem, Charles T., Hawkesbury Agricultural College, Richmond, New South Wales.
Nawa, Yashushi, Entomological Laboratory, Kyomachi, Gifu, Japan.
Newstead, Robert, University School of Tropical Medicine, Liverpool, England.
Porter, Carlos E., Casilla 2352, Santiago, Chili.
Pospielow, Dr. Waldemar, Bureau of Entomology, Morskaya 44, Petrograd, Russia.
Reed, Charles S., Mendoza, Argentine Republic, South America.
Ritzema Bos, Dr. J., Wageningen, Holland.
Rosenfeld, A. H., Ingenio Santa Ana, F. C. N. O. A., Tucuman, Argentina.
Sajo, Prof, Karl, Godollo-Veresegyhaz, Hungary.
Schoyen, Prof. W. M., Zoological Museum, Christiania, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Shipley, Prof. Arthur E, Christ's College, Cambridge, England.
Silvestri, Dr. F. R., Scuola Superiore di Agricoltura, Portici, Italy.
Theobald, Frederick V., Wye Court, Wye, Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tillyard, R. J., Cawthron Institute of Scientific Research, Nelson, New Zealand.
Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.
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Proceedings of the Thirty-Fifth Annual Meeting of the American Association of Economic Entomologists

The thirty-fifth annual meeting of the American Association of Economic Entomologists was held at the Massachusetts Institute of Technology, Cambridge, Mass., December 28 to 30, 1922.

The meeting convened at 10.30 A. M., December 28, and was called to order by President James G. Sanders.

The annual reports were read and routine business transacted. The address of the President was given at the afternoon session and this was followed by a program of papers. On that evening, the Section of Apiculture held its annual meeting in the auditorium of the Boston Society of Natural History.

Friday morning, December 29, a meeting was held of the Section of Horticultural Inspection. In the afternoon, a series of papers were read before the association, but this was preceded by a symposium on "Standards for the Training of Men who are to enter Professional Entomology." The entomologists dinner was held in the evening at Ford Hall, Boston. About 140 entomologists were present.

On Saturday morning, December 30, a joint meeting was held at the Massachusetts Institute of Technology with the American Phytopathological Society, the subject being "Plant Quarantines." The final session was held that afternoon.

Prior to the opening of the meeting of the Association, a joint meeting was held of the entomologists interested in extension work and in the Insect Pest Survey. A meeting was also held during the week of scientists interested in transmission of disease by insects to man. A number of members of the association attended this meeting.

The business proceedings form Part I of this report, and the addresses, papers, and discussions, Part II.

The proceedings of the Sections of Apiculture and Horticultural Inspection are also included.

Papers read at the joint meeting with the Phytopathological Society have been summarized and will be published in the JOURNAL OF ECONOMIC ENTOMOLOGY.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order by President Sanders at 10.30 A. M., Thursday, December 28, 1922. Over 200 members and visitors attended the session. The following members were present.

Aldrich, J. M., Washington, D. C.
Alexander, C. P., Amherst, Mass.
Allen, R. H., Boston, Mass.
Arnold, George G., Agricultural College, Miss.
Back, E. A., Washington, D. C.
Baker, A. C., Washington, D. C.
Bailey, H. L, Bradford, Vt.
Bailey, I. L., Northboro, Mass.
Balduf, W. V., Columbus, Ohio.
Ball, E. D., Washington, D. C.
Barber, G. W., Arlington, Mass.
Barnes, D. F., Melrose Highlands, Mass.
Barnes, P. T., Harrisburg, Pa.
Bartley, H. W., Silver Creek, N. Y.
Batchelder, C. H., Orono, Me.
Bentley, G. M., Knoxville, Tenn.
Beyer, A. H., Gainesville, Florida.
Blackman, M. W., Syracuse, N. Y.
Blake, D. H., Washington, D. C.
Babcock, K. W., Arlington, Mass.
Borodin, D. N., New York, N. Y.
Bourne, A. I., Amherst, Mass.
Brittain, W. H., Truro, N. S.
Britton, W. E., New Haven, Conn.
Brues, C. T., Boston, Mass.
Burgess, A. F., Melrose Highlands, Mass.
Caffrey, D. J., Arlington, Mass.
Cartwright, William B., Centralia, Ill.
Chapman, J. W., Dumagueta, P. I.
Chapman, R. N., Minneapolis, Minn.
Claasson, P. W., Ithaca, N. Y.
Collins, C. W., Melrose Highlands, Mass.
Compton, C. S., Urbana, Ill.
Cook, Mel. T., New Brunswick, N. J.
Cooley, R. A., Bozeman, Mont.
Cory, E. N., College Park, Md.
Craighead, F. C., Ottawa, Canada.
Crampton, G. C., Amherst, Mass.
Crosby, C. R., Ithaca, N. Y.
Crossman, S. S., Melrose Highlands, Mass.
Dean, George A., Manhattan, Kansas.
De Long, Dwight M., Columbus, Ohio.
Dohanian, S. M., Melrose Highlands, Mass.
Doucette, C. F., Doylestown, Pa.
Ellington, G. W., Washington, D. C.
Ellis, R. C., Arlington, Mass.
Ellis, W. O., Arlington, Mass.
Fackler, H. L., Knoxville, Tenn.
Felt, E. P., Albany, N. Y.
Fernald, H. T., Amherst, Mass.
Fink, D. E., Riverton, N. J.
Flint, W. P., Urbana, Ill.
Fracker, S. B., Madison, Wis.
Frost, H. L., Arlington, Mass.
Frost, S. W., Arendtsville, Pa.
Garman, Philip, New Haven, Conn.
Gibson, Arthur, Ottawa, Canada.
Glasgow, Hugh, Geneva, N. Y.
Glenn, P. A., Urbana, Ill.
Graf, J. E., Biloxi, Miss.
Graves, F. W., Jr., Melrose Highlands, Mass.
Griswold, Grace Hall, Ithaca, N. Y.
Guyton, T. L., Harrisburg, Pa.
Hartley, E. A., Syracuse, N. Y.
Haseman, Leonard, Columbia, Mo.
Headlee, T. J., New Brunswick, N. J.

Hine, J. S., Columbus, Ohio.
Hodgson, B. E., Arlington, Mass.
Hofer, C. E., Silver Creek, N. Y.
Hoffman, William E., St. Paul, Minn.
Hood, C. E., Melrose Highlands, Mass.
Hooker, W. A., Washington, D. C.
Horsfall, J. L., Bustleton, Pa.
Horton, J. R., Wichita, Kan.
Houser, J. S., Wooster, Ohio.
Howard, L. O., Washington, D. C.
Hyslop, J. A., Washington, D. C.

Jaynes, H. A., Riverton, N. J.
Johannsen, O. A., Ithaca, N. Y.
Jones, D. W., Melrose Highlands, Mass.
Kellogg, V. L., Washington, D. C.
Kennedy, C. H., Columbus, Ohio.
Lamson, G. H., Jr., Storrs, Conn.
Larrimer, W. H., West LaFayette, Ind.
Larson, A. O., Alhambra, Calif.
Lathrop, F. H., Corvallis, Ore.
Leiby, R. W., Raleigh, N. C.
Leonard, M. D., New York, N. Y.
Lowry, Philip R., Durham, N. H.
Lowry, Q. S., Canton, Mass.

MacLeod, G. F., Geneva, N. Y.
Manter, J. A., Storrs, Conn.
Marcovitch, S., Knoxville, Tenn.
Marlatt, C. L., Washington, D. C.
Martin, J. F., Washington, D. C.
McIntyre, H. L., Melrose Highlands, Mass.
McLaine, L. S., Ottawa, Canada.
Merrill, G. B., Gainesville, Florida.
Metcalf, C. L., Urbana, Ill.
Metcalf, Z. P., West Raleigh, N. C.
Minott, C. W., Melrose Highlands, Mass.
Mitchell, T. B., Raleigh, N. C.
Moore, William, Riverton, N. J.
Morse, A. P., Wellesley, Mass.
Mosher, F. H., Melrose Highlands, Mass.
Muesebeck, C. F. W., Melrose Highlands, Mass.
Newell, Wilmon, Gainesville, Florida.
Nolan, Willis J., Washington, D. C.

O'Kane, W. C., Durham, N. H.
Osborn, Herbert, Columbus, Ohio.
Osgood, W. A., Durham, N. H.
Packard, C. M., Sacramento, Calif.
Palmer, J. B., Ithaca, N. Y.
Parrott, P. J., Geneva, N. Y.
Patch, Edith M., Orono, Me.
Patch, L. H., Arlington, Mass.
Peirson, H. B., Augusta, Me.
Peterson, Alvah, New Brunswick, N. J.
Phillips, E. F., Washington, D. C.
Phillips, Saul, Saugus, Mass.
Phipps, Clarence R., Mountain Grove, Mo.
Popenoe, C. H., Washington, D. C.
Porter, B. A., Washington, D. C.

Reed, W. V., Atlanta, Ga.
Regan, W. S., Bozeman, Mont.
Robinson, J. M., Auburn, Ala.
Rogers, D. M., Boston, Mass.
Rohwer, S. A., Washington, D. C.
Rosewall, O. W., Baton Rouge, La.
Ruggles, A. G., St. Paul, Minn.

Sanders, G. E., Annapolis Royal, N. S.
Sanders, J. G., Harrisburg, Pa.
Sasscer, E. R., Washington, D. C.
Satterthwait, A. F., Webster Groves, Mo.
Schaffner, J. V., Jr., Melrose Highlands, Mass.
Schoene, W. J., Blacksburg, Va.
Shelford, V. E., Urbana, Ill.
Skinner, Henry, Philadelphia, Pa.
Smith, G. A., Boston, Mass.
Smith, M. R., Agricultural College, Miss.
Smith, R. H., San Francisco, Calif.
Smith, R. I., Boston, Mass.
Smulyan, M.T., Melrose Highlands, Mass.
Smyth, E. G., Washington, D. C.
Snapp, O. I., Fort Valley, Ga.
Snyder, T. E., Washington, D. C.
Spencer, G. J., Guelph, Canada.
Stearns, L. A., Leesburg, Va.
Summers, J. N., Melrose Highlands, Mass.
Sutton, F. J., Middleport, N. Y.
Swaine, J. M., Ottawa, Canada.

Tanquary, M. C., College Station, Texas.
Thomas, F. L., Auburn, Ala.
Tothill, J. D., Fredericton, N. B., Canada.
Treherne, R. C., Ottawa, Canada.
Vance, A. McC., Charlottesville, Va.
Van Dine, D. L., State College, Pa.
Vickery, R. A., Cambridge, Mass.
Wade, J. S., Washington, D. C.

Walton, W. R., Washington, D. C.
Webber, R. T., Melrose Highlands, Mass.
Weed, C. M., Lowell, Mass.
Weigel, C. A., Washington, D. C.
Wheeler, W. M., Forest Hills, Mass.
Whitmarsh, R. D., Milwaukee, Wis.
Winchester, H.I., Melrose Highlands, Mass.
Woods, W. C., Middletown, Conn.
Wooldridge, Reginald, Melrose Highlands, Mass.
Worthley, H. N., Amherst, Mass.
Worthley, L. H., Arlington, Mass.

President J. G. Sanders: It is my privilege to call to order the thirty-fifth annual meeting of the American Association of Economic Entomologists.

We will first hear the report of the Secretary.

REPORT OF THE SECRETARY

At the time of the Toronto meeting, the total membership of the association was 652, divided into the following classes: active, 282; associate, 322; foreign, 48. At that meeting, 36 associate members were elected and 19 were transferred to the active roll and one active and 7 associate members resigned. Since that time, 1 active member has died, 13 associate members have been dropped for non-payment of dues and 10 associate members that were elected at the Chicago meeting have been dropped on account of having paid no dues.

The present membership is 299 active, 310 associate and 48 foreign, making a total of 657, and a net gain of 5.

On December 10, 1921, Mr. Elbert S. Tucker, an active member located at Tallulah, La., passed away. He had been in poor health for some time. His scientific training was received at the University of Kansas, and he had been employed by the University of Kansas, Texas Agricultural Experiment Station, Louisiana Experiment Station and U. S. Bureau of Entomology. He was a faithful worker, and is greatly missed by those who knew him.

The Pacific Slope Branch held its annual meeting at the University of Utah, Salt Lake City, Utah, July 22d, in connection with the annual summer meeting of the Pacific Slope Division of the American Association for the Advancement of Science. An excellent program was presented, which was published in the December number of the Journal of Economic Entomology.

Certificates for the past presidents of the association were prepared and presented at the annual dinner at the Toronto meeting.

Journal of Economic Entomology

During the past year the price of printing the Journal has been slightly reduced, and owing to better facilities in the printing plant of our publishers, the issues have been mailed more promptly than heretofore.

As the result of the appointment of a Circulation Agent, which was authorized at the last annual meeting, it has been possible to materially increase the subscription list. Mr. C. W. Collins, who has taken over this work, has succeeded in interesting members in some of the states who have succeeded in securing many new subscribers. This work should be extended so that there will be in every state at least one member of the association actively seeking new subscribers. By following

this method continuously, it should be possible to greatly increase the circulation of the JOURNAL which in turn will make possible the publication of a greater number of papers.

At the close of the last year, the subscription list numbered 896. It now numbers 998. Earnest co-operation with Mr. Collins is requested and there is no good reason why this should not result in a very large increase in our subscription list.

For the first time in several years, it is now possible to announce that the funds loaned by the association to finance the JOURNAL have been repaid, and the publication is now on a self-supporting basis. The prospects are excellent for maintaining this status, and it should be a satisfaction for members of the association to know that the JOURNAL has passed through a difficult financial period without being obliged to materially curtail the number of pages published or be under obligation to the association or its members for any funds that were advanced during the past.

The supply of back numbers of the JOURNAL has been reduced by sales so that it will be advisable to increase the price of some of these volumes in the near future. All volumes except Volume I are now selling at $3.50 each. It is suggested that members desiring to complete their file do so without delay and take advantage of this opportunity before the price is increased.

Index to the Literature of American Economic Entomology, I

During the past year, a number of copies of this Index have been sold. As a result of this income, it has been possible to bind and place in cartons the 400 unbound copies of this publication. After defraying this expense there remains in the treasury approximately the same amount as was carried to the credit of that fund last year.

Index to the Literature of American Economic Entomology, II

A limited number of copies of this publication have been sold during the past year and the funds secured have been used in supplying cartons for 500 volumes and in paying outstanding loans. It has been possible to pay the last four notes of $25 each covering funds advanced by members to finance this publication and to return $225 to the association treasury in part payment of what was loaned on this account.

Index II now shows a deficit of $425. If sales during the next two years can be maintained in the same volume as during the last year, this amount can be liquidated.

Permanent Fund

At the Toronto meeting, the association voted, on recommendation of the executive committee, to establish a permanent fund, to which could be transferred each year a portion of the unexpended balance not required for current expenses. Before the adjournment of that meeting, the executive committee voted to transfer one—$100 Liberty Bond, which has been held by the association for several years, and $500 from the association treasury to this fund. It was understood that the Secretary should secure for the association a $500 Liberty Bond at the market price. This was done and the balance of the $500 deposited in the permanent fund. Since that time, by vote of the executive committee, $179.83 which has been carried for a number of

years in the Melrose Savings Bank, was transferred to the permanent fund, and recently $500 not needed for current expenses, has been similarly transferred. The total amount in this fund on the date of closing the books, was $1334.75.

Association Statement

Balance in Treasury, December 2, 1921		$1053.80
Amount received from dues, 1921		773.00
Amount received from Malden National Bank, Interset		14.31
Amount received from loans		475.00
Paid—Stenographic report, 1921 meeting	$164.96	
Postage	57.80	
Programs and notices	78.23	
Diplomas	46.00	
Supplies and stationery	55.34	
Telegraph and expenses	10.22	
Returned checks	3.59	
Expenses—Pacific Slope Branch	11.18	
Funds transferred	1179.83	
Clerical work, Secretary's office	45.00	
One-half salary Secretary	50.00	
Balance, December 2, 1922	614.05	
Grand Total	$2316.11	$2316.11

Balance, Deposited in First National Bank, Malden, Mass.

Journal Statement

Balance in Treasury, December 2, 1921		$1324.03
Amount received from subscriptions, advertising, etc		3620.36
Amount received from Malden National Bank, Interest		20.00
Paid, Postage	$91.30	
Printing	3404.44	
Notices	16.00	
Supplies and stationery	13.06	
Half-tones	165.15	
Telegraph and express	7.78	
Returned subscriptions	8.00	
Returned checks	8.25	
Loan paid	250.00	
Clerical Work, Editor's Office	75.00	
Salary, Editor	100.00	
Clerical work, Secretary's office	45.00	
One-half Salary of Secretary	50.00	
Balance, December 2, 1922	730.41	
Grand Total	$4964.39	$4964.39

Deposited in First National Bank, Malden, Mass.

Index I Statement

Balance in Treasury, December 2, 1921		$146.69
Received from sales		175.15
Paid for postage	$5.70	
Paid for binding	133.91	
Paid for supplies and stationery	21.29	
Balance	160.94	
Grand Total	$321.84	$321.84

Balance Deposited in First National Bank, Malden, Mass.

Index II Statement

Balance in Treasury, December 2, 1921		$28.83
Received from sales		329.16
Paid for postage	$5.87	
Supplies and stationery	25.85	
Paid for loans	325.00	
Balance	1.27	
Grand Total	$357.99	$357.99

Balance deposited in First National Bank, Malden, Mass.

Permanent Fund

1—4¼ Liberty Bond	$100.00
1—4¼ Liberty Bond	500.00
Transfer from association fund	179.83
Transfer from association fund	12.55
Transfer from association fund	500.00
Interest on bonds	25.50
Interest on deposit	16.87
Grand Total	$1334.75

4¼% Liberty Bonds—$600
Deposited in Melrose Savings Bank—$734.75

Summary

Balance in Index I account	$160.94
Balance in Index II account	1.27
Balance in Journal account	730.41
Balance in association account	614.05
Grand Total	$1506.67

Deposited in First National Bank, Malden, Mass.

Respectfully Submitted,
A. F. Burgess, *Secretary*

Voted that the report be accepted.

PRESIDENT J. G. SANDERS: We will now hear a brief report by Mr. C. W. Collins, Circulation Agent of the JOURNAL OF ECONOMIC ENTOMOLOGY.

REPORT OF CIRCULATION AGENT

At the Toronto meeting of this Association in 1921, it was voted that the Editorial Board be granted permission to designate a circulation agent of the JOURNAL. The writer was accordingly asked to take up these duties in January and with the counsel of your Secretary has since been working to interest new subscribers. In starting out I requested 59 working entomologists residing in most of the States and in the Provinces of Canada to assist in the work by acting as leaders in their respective territories. Copies of printed circulars describing the scope and usefulness of the JOURNAL to which a subscription order blankwas attached have also been supplied to the leaders. This cooperation has been successful in a measure with the result that some leaders have given freely of their time and energies toward directing subscriptions to the circulation Agent. About 1050 letters, mostly circular, have been written and sent in the interest of new subscriptions during the year.

The following table shows the total domestic and foreign subscribers in 1913, 1921 and increase in 1922, by states:

	1913	1921	1922		1913	1921	1922
Alabama	3	7	12	Nebraska	3	4	2
Arizona	7	5	6	Nevada	1	2	2
Arkansas	2	5	6	New Hampshire	4	7	7
California	34	65	63	New Jersey	14	22	23
Colorado	7	15	14	New Mexico	3	4	3
Connecticut	10	15	20	New York	52	40	61
Delaware	3	2	3	North Carolina	6	10	9
Dist. of Columbia	50	42	53	North Dakota	0	2	1
Florida	7	17	20	Ohio	22	32	33
Georgia	6	9	9	Oklahoma	2	4	4
Idaho	2	6	4	Oregon	10	12	11
Illinois	30	25	28	Pennsylvania	18	33	39
Indiana	16	13	13	Rhode Island	3	1	2
Iowa	5	14	12	South Carolina	4	3	1
Kansas	16	16	17	South Dakota	1	2	2
Kentucky	4	4	6	Tennessee	6	10	11.
Louisiana	12	15	13	Texas	16	24	25
Maine	5	6	5	Utah	8	13	13
Maryland	11	8	10	Vermont	1	1	1
Massachusetts	48	70	83	Virginia	7	14	15
Michigan	15	10	12	Washington	8	12	12
Minnesota	10	13	14	West Virginia	5	5	5
Mississippi	4	19	25	Wisconsin	6	11	15
Missouri	8	10	13	Wyoming	0	1	1
Montana	5	7	9				

Total for U. S.	520	687	768
U. S. Poss.	26		
Hawaii		10	11
Panama and Virgin Islands		3	2
Philippines		5	5
P. R. and Cuba		6	6
Canada	27	37	43
Foreign	132	148	163
Total	705	896	998

It will be noted that there is a substantial increase in many of the states during the past year and it is possible with the help of more entomologists who are in a position by acquaintance and contact with potential subscribers, to further increase the list during the coming year.

I wish to thank all leaders for their cooperation and help during the year and at the same time to appeal for their continued aid during the ensuing year. We have realized a gain of 102 new subscriptions during 1922 and it is possible to make a better showing during the coming year in that many sources in some of the States and Provinces have not yet been intensively worked.

Respectfully submitted,

C. W. Collins, *Circulation Agent*

President J. G. Sanders: We owe a vote of thanks to Mr. Collins for his fine work in increasing the number of subscriptions more than 100. I will now read the report of the Executive Committee.

REPORT OF EXECUTIVE COMMITTEE

Following recommendations adopted at the last annual meeting, this committee has examined and audited the accounts of the Secretary and found them to be correct.

This committee has sanctioned the proposal of the Secretary to transfer five hundred dollars of the unexpended balance in the association account to the permanent fund.

J. G. Sanders
J. M. Swaine
M. C. Tanquary
A. F. Burgess
Committee

Voted that the report be accepted and the recommendations adopted.

President J. G. Sanders: The next report will be presented by the delegate appointed to attend the conference to consider a Federation of American Biological Societies.

REPORT OF DELEGATE TO CONFERENCE CONCERNING FEDERATION OF BIOLOGICAL SOCIETIES

In November 1920 the Secretary of this Association was invited by Prof. A. Franklin Shull, Secretary of the American Society of Naturalists to attend a dinner

of the secretaries of the different Biological Societies during Convocation week at Chicago.

The invitation set forth the desirability of a conference concerning the arrangement of programs for the annual meetings in order to prevent conflicts, so far as possible, and to enable those attending to become better acquainted with the problems confronting the management of the different societies.

The meeting was held at 6.30 p. m., Dec. 27. The following gentlemen were present: Dr. C. E. McClung, then chairman of the Committee of Biology and Agriculture of the National Research Council, and the secretaries of societies, as follows: Prof. A. Franklin Shull, American Society of Naturalists, Prof. J. R. Schramm, Botanical Society of America, Prof. A. O. Weese, Ecological Society of America, Dr. J. M. Aldrich, Entomological Society of America, and the writer.

After the dinner was finished Prof. Shull stated his belief that much good could be accomplished by having the secretaries meet and discuss the problems that their societies were facing and that better arrangement for programs would probably be beneficial. He then called on Dr. McClung to preside.

The latter called attention to the independent nature of the different societies and suggested the desirability of closer relations, expressing the belief that this would be of benefit to all.

Prof. Schramm was called upon to discuss publications and presented data to show that costs of printing were too high and suggested the desirability of having one large publication which would serve all interests involved. This would make it possible to publish a larger edition and result in economy in printing. It was stated that this publication could be printed in sections which could be supplied to the members of the different societies covering the special lines in which they were interested. A common editorial staff would be necessary under this plan and the printing handled from one plant. It seemed probable that the cost of editing and management would be increased but the printing bill would be reduced.

Representatives of each society present were then asked to state the conditions and problems that confronted them, particularly with relation to programs and publications. It developed that most of the societies were experiencing difficulty in financing their existing publications and the need of more avenues to publish scientific work was stressed by some of those present. It was stated that the National Research Council had during the year past advanced funds to assist in the publication of Botanical abstracts.

In the general discussion that followed the suggestion was made by some one that the remedy for these troubles could be secured by combining the societies so as to relieve the financial pressure.

It was decided that it was advisable for the secretaries to meet each year and discuss matters of mutual interest and the suggestion was made that the matters brought up should be talked over with the appropriate committee of each society.

After adjournment the writer brought up this matter at the meeting of the Committee on Policy of this association which was held later the same evening, but no action was taken.

No meeting of the secretaries of the societies, as such, has since been held. On June 3, 1921, a conference was held in Chicago between representatives of the American Society of Naturalists, American Society of Zoologists and Botanical Society of America, for the purpose of providing in each of these societies a section for

genetics. The conference discussed a plan for federating the Biological Societies and passed the following resolution: "That the Division of Biology and Agriculture of the National Research Council call a meeting of officers or representatives of biological societies to meet at Toronto to discuss the formation of a federation of Biological Societies."

The Division of Biology and Agriculture passed the following resolution at their meeting July 24, 1921.

"That the Executive Committee on behalf of the Division of Biology and Agriculture of the National Research Council call such a meeting of representatives of biological societies, extending invitations to the societies represented in the Division and such others as may be considered practicable."

Conforming to this resolution a call was sent out by the National Research Council to the President and Secretary or other representatives of Biological societies to attend a meeting and dinner Dec. 27, 1921, at Toronto.

Twelve societies together with Sections F, G and O of the American Association for the Advancement of Science and the Division of Biology and Agriculture of the National Research Council were represented by one or more members.

After a brief explanation it was voted as the sense of the meeting that the inter-society conferences should be continued to consider the feasibility of federation and to develop plans and that each society and the Sections represented should designate their president and secretary as members of an inter-society council which shall be authorized (1) to deal with all matters of common interest, such as coordination of programs, that are consistent with the existing regulations of the constituent societies and (2) to draw up proposals for a constitution and by-laws of a federation of the societies in question, and to present them for action at the next annual meeting.

It was also voted that the Division of Biology and Agriculture of the National Research Council be requested to call a meeting of the Council early in the spring. After listening to a discussion of the benefits of the proposed federation, publications and the correlation of meetings and programs, the conference adjourned for dinner.

In January 1922 a letter was received by me as Secretary of the Association from Dr. Frank R. Lillie stating that he had been requested by the chairman of the Division of Biology and Agriculture of the National Research Council to look after the program for the meeting of the inter-society council. With it was a list of topics which it seemed desirable to discuss at the conference and a request for suggestions. The topics dealt with—I. arrangement for programs of the different societies and II. the scope of a federation and the constitution and by-laws that appeared desirable. In reply I expressed approval of arrangements for making the programs more satisfactory but stated that I was not convinced that closer affiliation than that arranged for by the council would be of material benefit to this association. In view of the character of some of the questions suggested for discussion that intimated that a "one big society" was under consideration, I expressed the opinion that this association for more than 30 years had been an independent body and I had no doubt but what it would wish to continue as such.

In February a letter was received from Dr. L. R. Jones, Chairman Division of Biology and Agriculture, National Research Council, stating that the conference would be held in Washington, D. C., April 23. It stated that a decision had been reached to invite one representative from each society to attend instead of the presi-

dent and secretary as previously planned. This would result in reducing the expense of holding the conference.

The matter was referred to the President of the association and I was appointed to act in that capacity which explains why I am making this report.

Prior to the time of the meeting an agenda was received with a request that it be given careful thought.

The conference was attended by the following organizations: American Association for the Advancement of Science; Sections F (Zoology), G (Botany), N (Medical Sciences), and O (Agriculture); American Society of Naturalists; American Society of Zoologists; Botanical Society of America; Genetics Sections of the Botanical Society of America and the American Society of Zoologists; American Genetic Association; Ecological Society of America; American Phytopathological Society; American Society for Horticultural Science; Society of American Foresters; Society of American Bacteriologists; American Society of Agronomy; Entomological Society of America; American Association of Economic Entomologists; American Society of Animal Production; American Dairy Science Association; Federation of American Societies for Experimental Biology; The Executive Committee of the Division of Biology and Agriculture of the National Research Council.

Each of the above societies and sections were represented by one delegate and the executive committee of the Division of Biology and Agriculture of the National Research Council by 7 members.

The conference organized with Prof. L. R. Jones as chairman and Prof. A. Franklin Shull as secretary.

Professor F. R. Lillie explained the agenda that had been sent out and it was decided that plans for the annual meeting, with relation to programs, etc., should be referred to a committee consisting of the secretaries of the American Society of Naturalists, Botanical Society of America and American Society of Zoologists, who would co-operate with the permanent Secretary of the American Association for the Advancement of Science.

After a general discussion the following committee was appointed to consider the situation and report at the afternoon session: Frank R. Lillie, University of Chicago; C. W. Greene, University of Missouri; I. F. Lewis, University of Virginia; C. E. McClung, University of Pennsylvania; A. Franklin Shull, University of Michigan; R. E. Thatcher, N. Y. Agricultural Experiment Station, H. B. Ward, University of Illinois; and B. E. Livingston, representing the American Association for the Advancement of Science.

They presented the following recommendations, which were adopted:

1. That the vote of the Toronto conference in favor of the idea of federation be reaffirmed.

2. That the proposed federation be styled the Federation of American Biological Societies.

3. That the members of the federation be societies, not individuals, and that all societies represented in this conference be eligible to charter membership.

4. That a council of the federation be established, consisting of two representatives from each society, these to be the president and secretary unless otherwise designated by the society.

5. That the council choose an executive committee from its own membership.

The same committee was continued to draw up a constitution and by-laws and report early in the fall.

The conference was then addressed by Dr. Kofoid, Dr. Schramm and Dr. Vernon Kellogg, relative to biological publications, the latter discussing the situation concerning bibliographies with particular reference to European conditions. The following committee was appointed to consider the subject of biological publications in cooperating with a similar committee of the Division of Biology and Agriculture, National Research Council: A. P. Hitchens, Army Medical School; I. F. Lewis, University of Virginia; C. A. Kofoid, University of California; D. R. Hooker, Johns Hopkins University.

On August 4 and 5, 1922, the committee appointed to draw up a constitution met at Woods Hole, Mass. All members were present except Dr. Livingston whose place was filled by Prof. Herbert Osborn.

The committee adopted three principles to be observed in setting up relations with existing organizations, viz:

1. The federation should, for its benefit, utilize other organizations in accordance with their nature and purposes.
2. The federation should, on the other hand, so direct its policies and methods as to strengthen the efforts of organizations with which it is affiliated.
3. The federation should avoid unnecessary duplication of effort and expenditure.

The proposed constitution was published in *Science* Sept. 29, 1922. Copies have been sent to each active member of this association and a supply is available for the use of those present at this meeting.

It is assumed that the members have studied this constitution and are prepared to determine whether it shall be adopted and the Association take membership in the federation. I have recently been advised that the name has been changed to the Union of American Biological Societies.

The question that naturally concerns us is in regard to the anticipated benefits that will result from this union. Substantially the same question was asked at the last annual meeting and the reply of our representative on the National Research Council was that it would enable biologists to control their own literature and enable the secretaries to hold a conference to avoid conflicts in programs and arrange symposia of interest to all.

The objects as stated in the Constitution indicate the purpose is to stimulate biological investigations, organize and promote the interests of bibliographies and publication and to do those things of broad scope that the individual societies cannot do for themselves.

These objects are worthy but it is difficult to see how this Association will profit greatly as a result of this new organization. Recently the principal inducement to membership centers around the possibility of better publication facilities. Improvement along these lines is very desirable but involves financial backing which must come either from the societies or from outside sources.

Even if no profit accrues we should be willing to do our part in any movement that will benefit biology in general.

It is evident that most of the Societies do not have sufficient funds to finance their share of any elaborate program for publications but it is possible that outside sources might be willing to do so.

This association is in sound financial condition and with conservative management

should be able to gradually improve its condition so far as publications are concerned.

In the judgment of the writer there will never be a time when the cost of publication will be so cheap, or the avenues for publication so easily available that every member will be able to publish all that he may wish. The JOURNAL serves a useful purpose to the membership and it is doubtful whether it should be discontinued in order for it to be replaced with a larger publication handling general biological matter at a greater cost.

We are reasonably well served with bibliographies but this condition could be improved if more funds were available.

Abstracts would be a welcome addition to entomological literature but the field is so great that it is a questionable project for us under present conditions. The index of Economic Entomology might be slightly modified so as to give an indication of the scope of the articles cited in the references and thereby increase its usefulness.

We cannot enter this Union without being willing to assume our just share of the responsibilities, financial and otherwise.

As your representative I have consulted several members of the association to obtain their views as to the benefits to be derived by us and by biology at large from this union.

The constitution provides that the Council may recommend but not impose assessments and that membership may be terminated by official notification to the Council. This protects the societies from excessive financial burdens. On this basis, and in anticipation that the influence of biology will be extended by this new organization, I think this association is warranted in accepting membership.

Respectfully submitted

A. F. BURGESS

The report was received but action on the recommendations deferred until the report of the committee on policy had been presented.

PRESIDENT J. G. SANDERS: The next report is by our Representative to the National Research Council.

REPORT OF REPRESENTATIVE TO THE NATIONAL RESEARCH COUNCIL

The annual meeting of the Division of Biology and Agriculture for election of officers for the ensuing year, the consideration of reports of the sub-committees, and the transaction of general business, was held on April 22, in the Board room of the Carnegie Institution of Washington. Dr. F. R. Lillie of Chicago University was elected chairman of the division. A meeting of the Executive Committee of the Division of Biology and Agriculture was held on August 25, at the Marine Biological Laboratory, Woods Hole, Mass.

Space and time prevents an enumeration of the reports of the activities of the Division of Biology and Agriculture, several of which show that the Division has already accomplished some definitely desired ends. Relative to the efforts in behalf of entomology should be mentioned the establishment of the Crop Protection Institute with which more than two hundred fifty scientific men and more than a score of industrial concerns have allied themselves. The institute has made ar-

rangements for some fundamental investigation in sulphur for the control of insects and plant diseases. F. H. Lathrop, Associate Professor of Entomology and Assistant Entomologist of the Oregon Agricultural College and Experiment Station, has been appointed to the sulphur fellowship of the Crop Protection Institute. He entered upon his duties September 1, 1922, and is working under the direction of Prof. P. J. Parrott of the New York Agricultural Experiment Station. Mr. J. W. Bulger, a graduate of South Dakota State College, with a Master's Degree from Ohio State University, 1922, was awarded the fellowship for the study of sulphur for the control of soil-infesting insects. Mr. Bulger is working under the direction of Dr. Herbert Osborn of the Ohio State University.

Under the Crop Protection Institute, cooperative dusting experiments have been carried out in the states of Pennsylvania, West Virginia, Connecticut, New York, Kansas, and Wisconsin. Details of the experiments and important results will be presented in various bulletins of the Crop Protection Institute. If time would permit, many illustrations could be given of splendid results acomplished by entomologists in these cooperative experiments, regional conferences, cooperating with industrial concerns and private agencies, all of which are fostered and supported by the Crop Protection Institute affiliated with the National Research Council. These conferences, which are stimulating interest in economic entomology and focusing attention on economic problems of outstanding importance, are almost certain to speed up research and experimental activities.

The meetings of the Division of Biology and Agriculture are not only a source of stimulation, but they also show very clearly that there is such an interrelation and interdependence of our problems in entomology with those of other fields in biology and science, that the development and solution of them cannot be considered separately without loss, and that the entomologist of the future will be required more than ever before to deal with problems involving interrelationships between many fields of science.

An invitation was extended to your representative on the National Research Council to attend the conference on Federation of the American Biological Societies, held on April 23, in the office of the National Research Council, Washington, D. C. This meeting was participated in by official representatives from the following organizations:

American Society of Zoologists
American Genetic Association.
American Society of Naturalists.
American Phytopathological Society.
Ecological Society of America.
Botanical Society of America.
American Society for Horticultural Science.
Society of American Foresters.
Society of American Bacteriologists.
American Association for the Advancement of Science, and its Sections G, F, O, and N.
American Association of Economic Entomologists.
American Society of Agronomy.
Entomological Society of America.
Federation of American Societies for Experimental Biology.

American Dairy Science Association.
American Society of Animal Production.

The conference, after considerable discussion, went on record in favor of a federation and appointed an executive committee to draw up a constitution to be submitted this winter at the annual meetings of societies represented in the federation conference. The report of this committee and the proposed constitution will be reported to this society by the Secretary and the Committee on Policy, together with the recommendation of the committee.

GEO. A. DEAN,
Representative of the American Association of Economic Entomologists to the National Research Council

Voted that the report be accepted.

PRESIDENT J. G. SANDERS: We will now hear the report of the Committee on Policy.

REPORT OF THE COMMITTEE ON POLICY

The Committee on Policy organized for the current year with the following Subcommittees:

EDUCATION—Dr. Ball, Chairman; Dr. Osborn; Mr. Dean.
INSECT CONTROL—Dr. Felt, Chairman; Mr. Burgess; Mr. O'Kane.
ORGANIZATION—Mr. O'Kane, Chairman; Mr. Sanders; Dr. Newell.
RESEARCH—Mr. Parrott, Chairman; Dr. Ball; Dr. Osborn.
PUBLICATION—Mr. Burgess, Chairman; Dr. Felt; Dr. Newell.

The Committee recommends that the Association enters the Federation of American Biological Societies under the proposed Constitution for such Federation as published in *Science* Vol. LVI, p. 359-361, Sept. 29, 1922, and that the Association maintain the designated representation of two members in this Federation at nominal expense. These representatives to be nominated by the Committee on Nominations.

The Insect Pest Survey is further commended by the committee, and greater cooperation on the part of all entomologists is urged.

The Committee affirms again its belief in the policy of thorough, deliberate, well-organized cooperation among federal workers, those employed in the various states and those who occupy similar positions in the Dominion of Canada. All problems in entomology are, to some extent, common to the workers in these various groups. Some problems cannot possibly be solved satisfactorily except through deliberate cooperation. The Committee believes that there should be:

(a). Conferences on specific problems of importance, these to be attended by all entomologists directly interested, no matter in what group they belong.

(b). Definite programs agreed on at such conferences with a full understanding of the major duties devolving on the several participants.

(c). A joint committee or council named by the conference, impartially constituted, and charged with the duty of helping to correlate work on the problem in question.

In the relations of industrial organizations to entomological work, the committee desires to express its confidence in the Crop Protection Institute. Experience is

proving that the plan under which the institute is organized is well chosen and that the Institute is in position to interest industrial concerns in entomological problems without prejudice, without risk of losing sight of scientific accuracy and with benefit to industry, to professional entomology and to the public welfare.

The Committee recommends that all entomologists become members of the Crop Protection Institute and give it their support and counsel.

The Committee offers this proposed amendment to the Constitution,—action on which will be taken at our next annual meeting.

Article II—Membership

Section 1. No change.

Section 2. Strike out this section and substitute the following: "The classes of membership shall be associate, active, fellow, honorary fellow and foreign."

Section 3. Strike out this section and substitute the following:

(a). Associate. Associate membership may be conferred on persons who have done general or practical work in Entomology and who have published papers or otherwise have given evidence of their interest in such work. An application for associate membership shall be endorsed by two active members.

(b). Active. Active membership may be conferred on associate members who have been trained in entomological work and whose practical experience or published papers have evidenced their attainments in Entomology.

(c). Fellow. Any member who has rendered exceptional service in Economic Entomology may be raised to fellowship rank.

(d). Honorary Fellow. Any fellow who has rendered distinguished and extraordinary service in Economic Entomology may be raised to honorary fellowship rank.

Section 4. No change.

Section 5. Strike out the section and substitute the following: "All classes of members, except associate and foreign members shall be entitled to vote in the general sessions. Associate members are entitled to vote only in the sectional meetings. All classes of members except associate and foreign shall be entitled to hold office."

Section 6. Strike out the section and substitute the following: "Membership of any class may be conferred at any regular meeting by a two-thirds vote of the members present, and on recommendation of the membership committee."

Section 7. Strike out the section.

With the proposed changes Article II—Membership—will read as follows:

Section 1. All economic entomologists, horticultural or apiary inspectors, employed by the General or State governments or by the State Experiment Stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology, may become members.

Section 2. The classes of membership shall be associate, active, fellow, honorary fellow and foreign.

Section 3. (a). Associate. Associate membership may be conferred on persons who have done general or practical work in entomology and who have published papers or otherwise have given evidence of their interest in such work. An application for associate membership shall be endorsed by two active members.

(b). Active. Active membership may be conferred on associate members who

have been trained in entomological work and whose practical experience or published papers have evidenced their attainments in entomology.

(c). FELLOW. Any member who has rendered exceptional service in Economic Entomology may be raised to fellowship rank.

(d). HONORARY FELLOW. Any fellow who has rendered distinguished and extraordinary service in Economic Entomology may be raised to honorary fellowship rank.

SECTION 4. Foreign membership shall be honorary and shall apply only to members residing outside of the United States and Canada.

SECTION 5. All classes of members, except the associate and foreign members, shall be entitled to vote in the general sessions. Associate members are entitled to vote only in the sectional meetings. All classes of members except associate and foreign shall be entitled to hold office.

SECTION 6. Membership of any class may be conferred at any regular meeting by a two-thirds vote of the members present on recommendation of the membership committee.

SECTION 7. The Committee on membership shall be composed of fellows only.

BY LAWS

ARTICLE III—DUES

Section I is changed to read as follows:

The annual dues of associate and active members and fellows shall be one dollar and fifty cents, which shall be payable in advance. No dues shall be payable from honorary fellows and foreign members. Annual dues shall not include subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY.

ARTICLE IV—MEETINGS

SECTION IV. Strike out No. 8 and No. 1 under the subheading "at the following session," These numbers fixing the time of the annual address of the president and the discussion thereof.

GEO. A. DEAN
J. G. SANDERS
A. F. BURGESS
WILMON NEWELL
E. P. FELT
HERBERT OSBORN
P. J. PARROTT
W. C. O'KANE
E. D. BALL
Committee on Policy

PRESIDENT J. G. SANDERS: I wish to state that the proposed changes to the constitution and by-laws are merely read at this time and that they will come up for action at the next annual meeting after having been published in the JOURNAL.

Voted that the report be accepted.

PRESIDENT J. G. SANDERS: The Trustees of the Crop Protection Institute will now make a report.

REPORT OF THE BOARD OF GOVERNORS OF THE CROP PROTECTION INSTITUTE

The organization of the Crop Protection Institute remains as it was last year. It is controlled by a Board of Governors of nine men, three of whom are named by this

Association, three by the American Phytopathological Society, two by the Association of Official Agricultural Chemists, and one by the National Research Council.

•On the Board of Governors station directors are represented, as it is now constituted, since both of the men named by the Agricultural Chemists are directors of stations.

Mr. Paul Moore is now Secretary of the Crop Protection Institute, being named on the Board by the National Research Council. The Treasurership is now the same as that of the research Council. All funds are handled through the regular machinery in the office of the Bursar of the National Research Council.

The industrial activity of the Institute has been widening and strengthening. The work of the Institute has gradually assumed a project aspect. By that I mean that its major activities are developing along lines of definite projects which are underwritten by specified funds made available to the Institute from various sources.

It has strengthened its research aspect. It has now two well supported active projects on hand which are almost entirely research in their aspects. That does not mean that there are not other aspects besides those of research, but wisely and properly research is coming to have a prominent part in its plans and activities.

The active projects are as follows:

1. Sulphur Investigations. The plans for these were completed this year. The fellowships are supported by the three large sulphur producing companies of this country—The Texas Gulf Sulphur Co., Union Sulphur Co., and the Freeport Sulphur Company. These united with the institute in a joint agreement, by which they are supporting research for a period of two years, at a total appropriation of fifteen thousand dollars. A special committee of the Board of Governors of the Institute is in charge of that research. This committee placed the proposition before station directors and some presidents of universities east of the Rocky Mountains, and were offered very substantial support by more than fifteen directors of stations and universities.

Two men were selected as investigators. The project was divided into two parts—the entomological aspect and the fungicidal aspect. Mr. F. H. Lathrop is the investigator in charge of the entomological aspect and Mr. H. C. Young is in charge of the pathological aspect.

It is a pleasure to say that unusual progress has been made in this work. The fungicidal aspect was begun first and Mr. Young has already worked out fundamental facts of great importance in the use of spray materials containing sulphur. Some of these discoveries will be set forth in a paper which will be read this afternoon before the plant pathologists and will be published as a bulletin by the Crop Protection Institute. I may indicate informally, that the data show that lime sulphur is a fungicide in a peculiar and unsuspected way, that its original caustic action is its first and most prominent fungicidal action, and that further fungicidal effects are due solely to precipitated, finely divided sulphur and not at all to the various compounds of sulphur in the material, as we had supposed before this.

The entomological aspect of the sulphur investigations is developing substantially. The Board is confident that both of these investigations will lead definitely to facts that are of great importance to our professional work and to that of the plant pathologists.

In this and in some other work that the Institute undertakes it seeks such expert counsel as may be available in industrial organizations. For example, the sulphur producing companies are represented in their contacts with the Institute by Dr.

Raymond Bacon, formerly a director of the Mellon Institute; by Dr. C. M. Chapman, another expert engineer; and by Mr. W. M. P. Taylor, who has been conducting certain experimental work. The Institute is keeping in touch with these men and is securing valuable help from them.

2. The second active project now provided for is an investigation of Scalecide, especially as to its possible effect on fire blight, on rate of twig growth, on borers, on the eggs of aphids and mites, and other problems. This is provided for in a three year contract with the B. G. Pratt Company, involving an appropriation of $13,500; or $4500 per annum. The Board expects to select immediately an investigator who will be set to work on this project. Various phases of the study will be located in various states; probably in three besides that in which the investigator himself is at work. Funds are available for carrying on related, corroborative work in these several states.

The status of this work is typical, I think, of what the Crop Protection Institute proposes to undertake in other instances. A procedure that shall apply to any such undertakings has been drawn up by the Institute with great care, in consultation with the authorities of the Department of Agriculture at Washington. This procedure provides safeguards that we believe will fully protect any investigation of this nature, supported by industrial funds, from bias or from the dangers that might arise in such support. Complete control of such projects, including the choice of investigators and all other details lies with the Board of Governors of the Institute, named by the national societies, as already described.

3. The third active project for which funds have been provided is that supported by the Tanners' Council of the United States, looking toward a program of control of the ox warble. Their appropriation is $9,000 and is contingent on additional funds which are in process of being secured.

There are pending projects that might be mentioned in detail, but it will perhaps suffice at this time to indicate that there are substantial undertakings in prospect, some of which I think will materialize soon.

The other general aspect of the work of the Institute is that of cooperative projects handled without specific appropriations but under such general funds as the Institute has. These consist largely in correlating certain work undertaken by various entomologists and plant pathologists.

For instance, we have finished a second year of orchard dusting experiments, involving five localities in as many states. We have carried out, this season, experimental treatment of cereal grains for smuts in some fifteen different states and provinces. We have conducted experimental treatment of seed potatoes. We have started a cooperative project in potato dusting, and so on.

I feel that in general the Institute is winning its way forward to a substantial contribution to entomology and to plant pathology. It needs your active cooperation and your counsel. It is impossible, obviously, for most of the scientific members to attend the annual meetings. That is unfortunate and ought to be otherwise. You can, however, write your views, your comments, your criticisms and your suggestions, to the Secretary or to the Chairman, and they will be welcome.

W. C. O'Kane
Chairman

Voted that the report be accepted.

PRESIDENT J. G. SANDERS: The report of the Committee on Nomenclature is now in order.

REPORT OF THE COMMITTEE ON NOMENCLATURE

Your committee, in attacking the project delegated to it, has employed tactics which are possibly a little unusual. It has given its attention not only to the compilation of a list of names but to the more fundamental conceptions of name formation and growth. Study has been given to suggestions submitted by various entomologists and editors, to dictionaries of the English language and to certain papers on Semantics. In fact an attempt has been made to review, in a preliminary way, the entire subject of the popular names of insects.

The position has been taken that, first of all, names born naturally should be favored and that any operative procedure in bringing names into being should be resorted to only when such natural born names are unavailable. It is further believed that since these names are for popular usage the question of academic entomological exactitude is less vital than that of simplicity and utility.

A preliminary examination has shown that no uniform system has heretofore been adopted in the consideration of the subject, inconsistencies of many kinds being at once evident. These were especially noted in the orthographic form of the compounds passed upon or suggested. While it is realized that rules for the form of compounds are scarcely traceable either in the ancient or modern periods of the English language it is felt that some plan of work should be prepared as a first step.

The use of the hyphen appears to have developed at about Shakespeare's time. In old English manuscripts such as those published by the Chaucer Society it is unknown. In the original edition of Shakespeare, on the other hand, the hyphen is excessively used, while Dr. Johnson used it in most common words in his dictionary and ran together unusual compounds such as ploughmonday.

Modern English usage is extremely irregular. In fact even on the same page of the same work one may find variable usage. The tendency, however, seems to be to hyphenate with first element stress or with a syntactical group as the first element. The modern tendency of printers appears to be to omit hyphens if authors permit and we have seen papers in which even the periods were not printed.

The fact that, during the past year, twenty or more members of this Association have given considerable thought and time to co-operative work on the project delegated to this committee, would indicate that the matter of common names is of general interest.

1,000 names, compiled from practically all the available American publications on economic entomology, have passed through the hands of systematists for the purpose of bringing the scientific names up to date. The list has been widely circulated. Every member of the Association who has expressed either a desire or a willingness to see the list has been supplied with a copy.

The present status of the list is what would logically be expected from a compilation; it represents, in an impartial way, the inconsistencies to be found in our entomological publications (past and present).

To edit this list of 1,000 names would be a haphazard performance without the use of rules to serve as guides in the choice and construction of the common names. Such rules should be basic enough to satisfy not only the present need but to serve future committees in the same capacity.

The present committee does not understand that it has authority to proceed in this manner without the expressed sanction of the general Association. If the Association is willing to vote to accept as rules for guidance in regard to common names, the list of suggestions hereto appended and forming part of this report which has been distributed for examination previous to this meeting, the committee thinks that the task assigned to it two years ago can proceed without further delay.

The present committee does not understand that it has been commissioned to modify (except editorially) any common names previously adopted by the Association. In certain cases such names are now known to be incorrect through misidentification or similar cause. Other names prove to be too cumbersome; and still others, even though simple, have not met with any universal usage. The committee, therefore, recommends that it be given authority to review the official lists and resubmit them with the new list prepared.

The editorial work on the list under consideration requires a very considerable amount of conference. Such conference is not possible among entomologists so widely distributed as are the members of the present committee. The committee, therefore, recommends that the Committee on Nomenclature be enlarged by four of the entomologists residing in Washington, Messrs. A. C. Baker; A. N. Caudell; J. A. Hyslop, and S. A. Rohwer, who have greatly aided the committee during the past year. This would make it possible to refer to taxonomists points of nomenclature, without the loss of time previously experienced; and would facilitate consultation on various matters important to the work of the committee.

Respectfully submitted,

Edith M. Patch
Arthur Gibson
Z. P. Metcalf
Committee

Suggested Rules

In preparing a set of rules as a first step in the study of names no attempt has been made to reflect the visible tendencies of modern English. Indeed this would be impossible. It is believed, however, that only such rules have been formulated as will give a better sense conception, and that the result of their application will not be far from the usual English usage.

Rule 1.—A common name should be given only when the insect is of particular interest on account of its economic importance, its striking appearance, or its abundant occurrence.

2.—When feasible a common name, used in any publication, should be accompanied by a reference to the scientific name. (This stand is taken because of the fact that the literature of entomology is international; and publications, even though popular, are often consulted by students outside our own colloquial sphere).

3.—A common name should, in general, be of two parts: one part indicating the family, group, or class to which the insect belongs; and the other a modifying part, limiting this to a specific insect. *Examples:* Striped blister-beetle, terrapin scale, fall armyworm.

4.—In compounding words the hyphen should be used to connect words which together form the group name; except when the last part of the name indicates an incorrect systematic group or when it is a noun implying an intransitive action, in

which cases no hyphen is to be used. *Examples:* Stink-bug, flea-beetle, leaf-miner, leaf-roller, twig-girdler, armyworm, sawfly, grasshopper, treehopper, froghopper, waterstrider.

5.—The hyphen should not be used to connect the group name and the modifying name. *Examples:* Bean weevil, yellow mealworm, hop aphid, plum curculio.

6.—When two or more words, expressing one idea, are included in a modifying part of the name, these words should be connected by the hyphen. *Examples:* twelve-spotted cucumber-beetle, grape-berry moth.

7.—When two distinct ideas are expressed in the modifying part of the name the hyphen should be omitted between the words representing these separate ideas. *Examples:* Round-headed apple-tree borer, Florida red scale.

8.—Group names:

The use of systematic group names as a basis for common names should be discouraged. *Examples:* Green diabrotica, two-spotted doryphora, oak eriococcus.

When a well known English name exists for a group, family or a number of insects with similar habits or similar characteristics, it should be used in preference to any other. *Examples:* Beetle, weevil, walkingstick, scale, leaf-roller.

9.—Modifying words:

The modifying names should be based, if possible, on some outstanding characteristic of the insect; and the direct translation of other than descriptive specific names should be avoided. *Examples:* (satisfactory) oyster-shell scale, two-striped walking-stick; (unsatisfactory) Abbot's sawfly, Baker's mealy-bug.

The modifying name may be based on a geographic region which constitutes the original home of the insect or in which it first attained economic importance, but the adoption of such names is to be discouraged. *Examples:* Oriental peach moth, American cockroach, San Jose scale, Japanese beetle.

The modifying name may be based on a co-relation between the insect and its host. *Example:* Emasculating bot-fly.

The modifying name should not be based on the name of an insect's host unless this host is known to be its outstanding and important one, *Examples:* Pear thrips, wheat midge, cabbage aphid, corn billbug not chufa billbug.

10.—More than one host-plant should not be used in a common name. *Examples:* Plum and thistle aphid.

11.—While in certain exceptional instances it may be advisable to sanction two different common names for the same insect, this is objectionable and a practice to be avoided. *Examples:* Bollworm, corn earworm: cotton aphid, melon aphid.

12.—Names already in common use should be retained in so far as is possible; but they should be made to agree in formation with the recommendations in paragraphs 3–7 inclusive.

Mr. E. P. Felt: I move that the report be accepted and the recommendations of the committee be approved.

Mr. S. B. Fracker: I would like to amend the motion so as to indicate that it is the sense of this meeting that the use of the hyphen in common names of insects be eliminated to as great an extent as the committee finds feasible.

The motion as amended was carried.

PRESIDENT J. G. SANDERS: We will next have the report of the Committee on Index of Economic Entomology.

REPORT OF THE COMMITTEE ON THE PUBLICATION OF THE INDEX OF AMERICAN ECONOMIC ENTOMOLOGY

Your Committee has kept in touch with developments during the past year and has not felt justified in attempting the publication of an Index prior to the expiration of a five year period. There are several bibliographic enterprises in operation or projected and so far they have not rendered an Index of economic entomology unnecessary.

The Report of the Secretary gives the financial details for both Index I and Index II and on referring thereto, it will be seen that the status of the project is very satisfactory and that soon a substantial balance will be available to assist in the publication of another volume.

Your Committee concurs in the advisability of publishing the Index at the end of the five year period unless developments in the near future make a change in plan advisable. In view of this, it is recommended that the Committee be continued and directed to make such plans as may be necessary to insure the publication of the next Index shortly after the expiration of the period to be covered.

Respectfully submitted
E. P. FELT
A. F. BURGESS
W. E. BRITTON
W. C. O'KANE
W. E. HINDS
Committee

Voted that the report be accepted and the Committee continued.

PRESIDENT J. G. SANDERS: There will be no formal report from the Committee on U. S. National Museum.

In accordance with the vote of the association at the Toronto meeting, the Committee on Resolutions was appointed by the President more than a month ago, with the following membership: Dr. W. E. Britton, Chairman; L. S. McLaine and E. C. Cotton.

I will now appoint the Committee on Nominations, as follows: R. A. Cooley, Chairman; Wilmon Newell and D. M. DeLong.

At this point the President read a letter received by the Secretary under the date of December 21, from the Managing Editor of *Popular Science Monthly* expressing interest in entomological research and suggesting that there might be members of our association who would be interested in preparing popular articles on current entomological developments for that publication. He also read a letter from T. A. C. Schoevers, Wageningen, Holland, who is Secretary of the Inter-

national Conference of Phytopathology and Economic Entomology, which will be held in Wageningen, Holland, June 25 to 30, 1923, and requested that representatives from this association be sent to the conference.

It was voted that the Executive Committee be authorized, in its discretion, to appoint a delegate to attend the conference.

Secretary A. F. Burgess explained the details of arrangements for the different sessions and stated that a very complete exhibit illustrating the corn borer work, gipsy moth work, and the operations at the vacuum fumigation plants supervised by the Federal Horticultural Board in Boston, had been prepared and were in a nearby room. An exhibit by members of the Entomological Society of America was also in the same room. In arranging for the meeting it seemed impractical to provide for a visit to the corn borer laboratory and the gipsy moth laboratory on account of lack of time and possibility of bad weather, and the exhibits above-mentioned have been prepared in order to replace such an excursion.

At this point the session adjourned and reconvened at 1.45 p. m.

President J. G. Sanders: We will now take up the proposal to enter the Union of American Biological Societies.

Mr. E. D. Ball: I move that this association join the proposed Union.

After the motion had been seconded, Mr. Ball stated that several associations had already ratified the proposed constitution and that he had been told within the last two or three hours that it was practically certain that if it was ratified by all the associations so as to make the project large enough to be worth while, that there is $2,000,000 available for publication of a bibliographic publication. He stated that it was not possible to get this fund unless there can be a union of all the biological societies; in case this is brought about, however, it is practically certain that there will be an endowment to make a permanent bibliographic Journal.

Mr. L. O. Howard: The American Association for the Advancement of Science this morning approved the movement on condition that all the societies join.

Secretary A. F. Burgess: I think it is very gratifying to hear the announcement Dr. Ball has just made in regard to the possibility of endowment because one of the prime difficulties has been the financial one and up to the present time there has been some uncertainty as to just how that could be worked out. It adds a good deal of impetus and

stability to the project to have it known that there is to be a source of adequate financial backing.

The motion was carried.

Final Business

The final business was transacted Saturday afternoon, December 30.

President J. G. Sanders: Is the Committee on Resolutions ready to report?

REPORT OF COMMITTEE ON RESOLUTIONS

1. *Resolved,* That the Insect Pest Survey is and may continue to be of much benefit to entomologists and crop producers, and that it should be continued over a period of years and perfected to bring it to its maximum degree of efficiency.

2. *Resolved,* That the Secretary consider the advisability of grouping together papers on allied subjects, and that two or more groups of this association may be held simultaneously so as to permit more time for the discussion of papers, and also that he arrange for a symposium on subjects of personal or general interest to the members of the association as a whole.

3. *Resolved,* That it is the sense of this association, that a uniform United States tag should be required to permit interstate movement of nursery stock and that the machinery necessary to the qualifying inspection should be worked out co-operatively between the United States Department of Agriculture and the authorities of the various states.

4. *Resolved,* That this association favors continued co-operation between the United States and Canadian Governmental authorities for the control of imported insect pests and also between the Federal authorities and the States for the same purpose.

5 *Resolved,* That this association recognizes at this time that the Japanese Beetle is a very serious menace to the agriculture and horticulture of the United States, and urges that every possible effort be made to restrict its spread.

6. *Resolved,* That this association records itself as favoring the plan of maintaining a barrier zone extending from Long Island Sound to the Canadian border, west of which the gipsy moth shall not be allowed to establish itself, and that a similar barrier zone be maintained in Canada.

7. *Resolved,* That this association appreciates the serious menace offered by the continued spread of the European Corn Borer and favors the expenditure of all the available means and resources which promise to prevent or delay the spread of this insect to the corn belt areas, especially careful quarantine administration and repressive work in the western infested areas surrounding Lake Erie are believed to be particularly important, also the possibility of commercial spread of the insect from the two generation colony in New England to the corn belt states should be given proper consideration.

8. *Resolved,* That this association expresses its high appreciation regarding the very instructive exhibits, particularly of the gipsy moth and European Corn Borer. Such exhibits are of great educational value and should be arranged in connection with these meetings wherever and whenever possible.

9. *Resolved*, That the thanks of this association be hereby extended to the Massachusetts Institute of Technology for furnishing place for meetings and exhibits, and to Professor Prescott and his associates on the local committee for making arrangements, and to the press for reporting, all of which have contributed toward the success of this meeting.

Respectfully submitted,
W. E. Britton
L. S. McLaine
Committee

Voted that the recommendations be adopted.

Prior to final vote, Mr. E. P. Felt briefly explained Resolution 6 relative to the selection of a barrier line to prevent further spread of the gipsy moth, and Mr. E. D. Ball cited the recent work in New Jersey to indicate that this plan was feasible.

President J. G. Sanders: The next in order will be the report of the Committee on Membership.

REPORT OF COMMITTEE ON MEMBERSHIP

The committee on membership submits the following report:

1. It recommends for election to associate membership,—
(The addresses will be found in list of members)

Alcazar, Manuel
Alexander, C. P.
Amis, A. H.
Ashworth, J. T.
Barnes, D. F.
Basinger, A. J.
Bigger, J. H.
Bissell, T. L.
Blake, D. H.
Boldyrer, Vassily F.
Buys, J. L.
Corkins, C. L.
Cowles, R. B.
Craighead, F. C.
Crumb, S. E.
Cutright, C. R.
Dunnam, E. W.
Ellington, G. W.
Ellis, R. C.
Fitch, H. W.
Flebut, A. J.
Fletcher, R. K.
Gable, C. H.
Gardner, T. R.
Gibson, L. E.
Glasgow, R. D.
Good, H. G.
Graves, F. W., Jr.
Hartley, E. A.
Hobson, R. T.
Holdridge, F. L.
Hough, W. S.
Ingram, J. W.
Jaynes, H. A.
Johnson, J. Peter
Keen, S. E.
Keyes, Elizabeth
Lange, R. C.
Langford, G. S.
MacLeod, G. F.
McClendon, S. E.
McIndoo, N. E.
Mickel, C. E.
Mitchener, A. V.
More, J. D.
Murray, M. A.
Noble, W. B.
Palmer, J. B.
Parker, R. L.
Patch, L. H.
Patts, S. F.
Remy, T. P.
Rogers, Leslie
Rohwer, S. A.
Roullard, F. P.
Sanders, P. D.
Sechrist, E. L.
Sibley, C. K.
Smit, Barnard
Smith, H. D.
Smyth, E. G.
Spencer, G. E.
Spencer, G. J.
Stirrett, G. M.
Sturtevant, A. P.
Sutton, F. J.
Vance, A. McC.
Vorhies, C. T.
Van Leeuwen, E. R.
West, L. S.
Wymore, F. H.

2. The committee recommends for re-instatement to associate membership,—

Babcock, K. W.	Runner, G. A.	Vaughan, E. A.
Frost, H. L.	Tillery, J. L.	

3. The committee recommends for transfer from associate to active membership,—

Allen, H. W.	Hill, C. C.	Reinhard, H. J.
Baerg, W. J.	Horsfall, J. L.	Smith, R. H.
Cartwright, W. B.	Knull, J. N.	Watson, J. R.
Champlain, A. B.	Laake, E. W.	Webber, R. T.
Claassen, P. W.	Leach, B. R.	Wellhouse, Walter
Crawford, H. G.	Marcovitch, S.	White, W. H.
Drake, C. J.	Mote, D. C.	Williams, C. B.
Dudley, J. E., Jr.	Muesebeck, C. F. W.	Young, D. B.
Fluke, C. L.	Porter, B. A.	
Gentner, L. G.	Reed, W. V.	

4. The committee recommends that the resignation of the following members be accepted,—

Henderson, W. W.	Neuls, J. D.	Wehr, E. E.
Lobdell, R. N.		

5. And finally the committee recommends that the 6 active and 20 associate members who are in arrears for dues for two years past, be notified that if these dues are not paid within a reasonable length of time, that the Secretary be instructed to drop the names of these members from the roster of this association.

Respectfully submitted,
A. G. Ruggles
J. S. Houser
Geo. G. Ainslie
Committee

Voted that the report be accepted.

President J. G. Sanders: We will now have the recommendations of the Advisory Committee of the Journal for officers for that publication.

Mr. L. O. Howard: The Advisory Committee have instructed me that they are unanimously in favor of continuing the present officers, as follows: Editor, E. P. Felt; Associate Editor, W. E. Britton; Business Manager, A. F. Burgess.

Voted that the recommendations be adopted.

President J. G. Sanders: We will now have the report of the Committee on Nominations.

REPORT OF THE COMMITTEE ON NOMINATIONS

Your committee appointed to nominate officers for the American Association of Economic Entomologists for the year 1923 respectfully reports as follows:

For President, Prof. A. G. Ruggles, St. Paul, Minn.

For First Vice-President, Prof. H. A. Gossard, Wooster, Ohio.

For Second Vice-President, Prof. H. J. Quayle, Riverside, Calif.

For Third Vice-President, Mr. P. A. Glenn, Urbana, Ill.

For Fourth Vice-Preisdent, S. B. Fracker, Madison, Wisc.

For the Committee on Membership for the term expiring 1925, Dr. W. E. Britton, New Haven, Conn.

For the Committee on Policy for the term expiring 1927, Dr. J. M. Swaine, Ottawa, Canada.

For Committee on U. S. National Museum for the term expiring 1927, Dr. O. A. Johannsen, Ithaca, N. Y.

For Representative to the National Research Council, Prof. George A. Dean, Manhattan, Kan.

For Councillors for the American Association for the Advancement of Science,
Dr. T. J. Headlee, New Brunswick, N. J.
Dr. L. O. Howard, Washington, D. C.

For Trustee for the Crop Protection Institute for the term ending 1925, Prof. P. J. Parrott, Geneva, N. Y.

For additional members of the Committee on Nomenclature,
Mr. J. A. Hyslop, Washington, D. C.
Mr. A. N. Caudell, Washington, D. C.
Mr. A. C. Baker, Washington, D. C.

We also recommend that Mr. S. A. Rohwer, Washington, D. C., be invited to co-operate in the work of this committee.

For Representatives to the Council of the Union of American Biological Societies,
Dr. A. L. Quaintance, Washington, D. C.
Dr. William Moore, Riverton, N. J.

For the Journal Advisory Committee for the term expiring 1925,
Dr. E. F. Phillips, Washington, D. C.
Prof. G. F. Ferris, Stanford University, Calif.

Respectfully submitted,
R. A. Cooley
Wilmon Newell
D. M. DeLong
Committee

It was voted that the Secretary be instructed to cast one ballot for the names recommended by the committee.

Carried.

The ballot was cast and the officers were declared elected.

President J. G. Sanders: Is there any miscellaneous business?

Secretary A. F. Burgess: We have held a joint meeting with the Phytopathologists for three years and the secretary of that society spoke to me this morning in regard to plans for the future.

I suggested that he consult the members of his society and I would consult this association in regard to the matter. I think it would be well to get an expression from the members here as to what they would like for a symposium at a joint meeting.

President J. G. Sanders: It seems to me that we can find some topic for discussion next year that would be beneficial to both societies.

Mr. W. C. O'Kane: I was one of those who was very much in favor of a joint meeting with the Phytopathologists. I do not believe we necessarily need to have a joint meeting every year unless there is obvious reason for it. If it is difficult to find a subject, I do not think it would be harmful to omit the joint meeting one year.

I move that the question of joint meeting be left to the Secretary or the Executive Committee, as the plans may develop in the next few months.

The motion was carried.

Secretary A. F. Burgess: The Committee on Resolutions recommended that the Secretary provide a symposium at the next annual meeting. It would be helpful if members would send in subjects that they think could be used in a symposium.

At this time I would like to offer an amendment to the constitution which, of course, will lay over for action until the next annual meeting.

Amend Article 2 of the Constitution by adding "Any member who shall pay to the association the sum of $100 may be made a life member and shall thereafter be exempt from dues and shall be furnished the Journal of Economic Entomology without further charge."

Mr. W. E. Britton: I move a vote of thanks to the President for presiding so nicely at this meeting and making so many suggestions for our mutual benefit.

Carried.

President J. G. Sanders expressed his thanks to the association and also his appreciation of the work done by the Secretary in making the meeting a success.

He then requested Past Presidents Felt and Cooley to escort Mr. A. G. Ruggles, President-elect, to the Chair.

He then presented him with the gavel belonging to the association and wished him success during the coming year.

President-Elect Ruggles thanked the association and promised to use his best efforts for the benefit of the association.

Secretary A. F. Burgess: I move that the time and place of the

next meeting be the same as that of the American Association for the Advancement of Science.

The motion was carried.

Mr. L. O. Howard stated that the next meeting would be in Cincinnati and the meeting the following year in Washington.

There being no further business, the meeting was adjourned at 3.30 P. M.

A. F. Burgess,
Secretary

PART II, ADDRESSES, PAPERS, AND DISCUSSIONS

Afternoon Session, Thursday, December 28, 1922

At the close of the business session, President Sanders called upon Past President Cooley to preside.

Past President Cooley: We will now listen to the annual address of our President.

WHITHER IN ENTOMOLOGY

By J. G. Sanders, *Harrisbvrg, Pa.*

Abstract

Predictions for the future are extremely hazardous in spite of the wonderful progress of the past thirty-five years. Our present day knowledge of Entomology should be more generally utilized in the schools, particularly the lower grades, since this will develop in the coming generation a more open mind toward improved methods. There is need in Entomology for men with breadth of training, deep convictions, lofty purposes and persevering ingenuity, men who believe in the profession and are capable of convincing others. Do the present day Entomologists compare favorably with the wonderful early workers, both in results and the relative cost of investigations? Is there a desirability of segregating more sharply the experimental and control or police phases? The remarkable results obtained in heat control, vacuum fumigation, etc. open tremendous new fields with numerous practical applications. Preventive control of insects, akin to preventive medicine, has possibilities of great development.

The honor of election to the presidency of an association of one's peers in his favored branch of science demands more than common thanks, more than average effort, more than complacent compromise and more than meaningless statement. The opportunity which you have afforded me at this thirty-fifth annual meeting, I am most happy to accept by offering some thoughts and convictions relative to the growing demands,

the encouraging outlook and the attainable station of Entomology among allied branches of science and in world activities generally. Altho considerable intermittent thought has been directed to the subject above, it is but natural to regret that a panacea cannot be found to ameliorate and remedy the many difficulties which are most certainly encountered in the pursuit of our profession wherever and however one may be engaged.

A review of wonderful accomplishments and of work replete with charm and precision in the past thirty-five and more years under limitations which often seriously hampered the progress of our most determined workers is most reassuring, but one who boldly tries to look into the future places himself in a precarious and assailable position, particularly if he should take liberties with the pet theories and beliefs of his peers. However, it can be asserted fearlessly that every thinking economic entomologist, be he veteran or novice, has experienced moments of misgiving and of conservative contemplation on what the future holds for his branch of science and for himself as a participant in its development. Would that I had the remarkable foresight of a Tennyson who in his "Locksley Hall," written in 1842, foretold "the nations' airy navies grappling in the central blue," and following on a few lines in the same poem wrote the oft quoted words—"Science moves, but slowly, slowly, creeping on from point to point." Just below we find another finely calculated thought as follows—

> Yet I doubt not thro' the ages one increasing purpose runs,
> And the thoughts of men are widen'd with the process of the suns
> Knowledge comes, but wisdom lingers, and I linger on the shore,
> And the individual withers, and the world is more and more.

In line with Tennyson's thought and doubtless in accordance with the procession of time, each of us shall play his part, add his mite to the sum total and finally move on. But how large and of what weight and influence shall the individual contributions be? Will they hinder and retard normal development or will they accelerate and quicken the pulses of our activities, rapidly, accurately, and with painstaking nicety fitting into the great scheme of world advancement? Is our chosen branch of science to remain in its present somewhat somnolescent state in which its very name is everywhere misspelled and its scope is but vaguely understood and generally misapprehended, or shall we adopt reasonable, efficient and palatable methods to attract and hold the public in a profoundly interesting and gripping study of living creatures? Altho the major development of our science has been contemporary with that of

bacteriology, have we, generally speaking, approximated the publicity secured to the latter? Yet we are for the most part dealing with creatures visible to the unaided eye and of most remarkable coloration and conformation, and which lend themselves readily to observation, study and a reasonable accumulation of knowledge thereof. It should be our legitimate desire to force our present day knowledge of entomology into our public schools, especially in the lower grades where early impressions will be strong to continue science study, so that the distaste for natural science so evident in higher grades, due largely to the average uninterested teacher's method of giving medicinal doses of science from a textbook, may be avoided.

In that phase of economic entomology pertaining to definite pest control, remarkable advancement has been achieved, and our knowledge of practical control covers a wide range of methods, which surely are easy of application and entail but slight expense in comparison with the benefits to be derived. But with all this amazing fund of knowledge available to the entomologist, we are startled on every hand either with the sublime indifference of the layman or his complete ignorance of facts. One realizes afresh this amazing ignorance of otherwise educated people every time he mentions the subject of entomology in public, and honestly senses his efforts to educate as well-nigh fruitless. Shall we not realize and confess here and now that a permanent barrier and handicap to a general diffusion of knowledge of insects and pest control will exist so long as we permit our children to grow to mature years without a reasonable fundamental knowledge of the simpler characteristics of insects and their habits coupled with an appreciation of damage wrought by them. Can we not see the very distinctive advantage in broadcasting advice on control of a new pest if our efforts were expended on individuals whose minds were partially prepared and receptive?

There is in course of preparation in the Pennsylvania Department of Education a compilation of elementary science studies submitted by scientists in various institutions, which will be edited and unified by the Director of Science Study for the purpose of introduction in the secondary schools of the state. These science studies, illustrated consistently with experiments and visual tests of easily obtainable materials, thoroughly yet concisely explained step by step, we believe will serve to open a new world to the younger children, and acquaint them in a pleasing and attractive manner with nature's methods and her creatures. Then can we not safely predict when hundreds of thousands of these informed children have grown to manhood and womanhood they will accord a more

hearty reception to our pest control preachments, and they in turn encourage and inspire our efforts to lessen and lower the heavy tax burden created and maintained annually by pests. The outlook for this field of effort is highly encouraging and once started and maintained for a few years should gather great momentum. At the outset the greatest care must necessarily be maintained to prepare the lessons and experiments so that they will be attractive, entertaining, and finally, powerfully instructive. To succeed in this program, the right men must meet the complex problems in an open-minded manner and patiently continue the endeavor in spite of recurring apparent failures. This brings me to another phase of this paper which I wish to discuss hopefully.

The entomologist, as a trained man in natural science, is to receive consideration in a symposium later in our program. In arranging this phase of our program the speaker was highly gratified with the ready and willing responses to his call for the several tasks, and it is our belief that the selection by the association of this generalized subject for a symposium will be amply justified.

Entomology is not unique among other sciences or professions, in that its outstanding need is for real men, with breadth of training, with deep convictions, with lofty purpose, with persevering ingenuity, with nice discrimination, with profound judgment, with generosity of spirit, with abounding health, and above all a reasonably tolerant attitude toward his fellow workers, which, however, should not leave him spineless and inclined to tread the paths of least resistance to detriment of himself and staff. In all kindness to an erring fellow worker, it is better to call him to account early, than to permit matters to proceed to an unfortunate state, where drastic correction is occasionally a distasteful and acute solution.

We will all agree, I believe, that many of our entomologists are inconsiderate of their health, failing to take the proper amount of regular exercise to maintain the dynamic force and brimming energy of body and mind which succeeds. We owe it to ourselves, our families and to our profession to take some form of regular exercise, preferably out-of-doors, and perhaps to reduce smoking when indulged to excess. Further, the aspiring entomologist should observe as far as is reasonable the habits and customs of well dressed people and maintain a presentable appearance on occasion. Let it not be said that entomologists compose any considerable part of "those queer scientists" in the common parlance, for there is not a single reason why an entomologist should not pass anywhere as far as appearances go for a successful business or profession-

al man. If we would place our profession where we would like to see it, we must mingle with our clients and the public, and in every legitimate way impress on them the importance of our profession and its achievements on the economics of world activities wherever applicable.

Has the entomologist been dilatory in his attitude toward allied fields of science and the earnest workers engaged in them? Has he been cognizant to the fullest degree of the tremendous advantages accruing from frequent contact with investigators and operators in any and all fields of human effort? Has he absorbed the enthusiasm of the salesman, the zeal of the merchant, the precise accuracy of the engineer, the tact and diplomacy of the stateman, and above all is he hopeful and courageous? Has he the conviction and belief in his own problems and efforts to the extent of demanding adequate financial support from the proper sources, or is he supinely accepting the crumbs dropped from the appropriation table after other branches of work have taken their portion? If you need something, go after it and persevere, for there exists a certain combination of audacity and calculation which assures success. Will he enforce quarantine laws and prosecute violators and wrongdoers? If one does not believe in his profession and have an abiding faith in it, it is better that he relinquish it and seek another business.

THE GOAL

BY BURTON BRALEY

Most men are drifting
And changing and shifting
In all that they plan and they do.
Their schemings are hazy,
Their purpose is lazy,
They have no objective in view.
But those who're successes
Are not fooling with guesses;
Such casual ways they abhor.
They know WHERE they're going
And WHY they are going,
And WHAT they are going for.

It's not that they're clever,
But all their endeavor
Of mind and of body and soul
Is wisely selected
And grimly directed
To reach to some definite goal.
They've laid out their forces
On well chosen courses

To win in Life's clamorous war
They know WHERE they're going
And WHY they are going,
And WHAT they are going for.

On history's pages
Down all of the ages
The names that are written in fire
Are those, who undaunted
KNEW JUST WHAT THEY WANTED
And never forgot their desire.
The lesson is there for
Your use if you care for
A place in the dominant corps
Know WHERE you're going
And WHY you are going
And WHAT you are going for.

The financial problems connected with entomology constitute an ever-increasing arduous duty, especially to heads of bureaus or divisions. Not alone are demands on the increase and costs of supplies and travel excessive, but the multiplicity of new problems arising from year to year are often causes of deep concern. In addition to these phases of finance, the question may be raised as to whether we are, by our efforts and the results obtained and information dispersed, justifying the expenditure of the large funds which are made available, and which would represent interest on vast sums. Are we measuring up adequately to some of those wonderful early workers, who accomplished much of lasting value from investigations at slight cost of operation? Should we not take stock occasionally and account for our stewardship?

Whither are we going in entomology? To what extent is the rapid development of the past 25 years, since 1897, when the writer took his first course in entomology, an index to future activity and an indication of future development? Should the same policies be continued in grouping of projects or will there appear the desirability of segregating more sharply the experimental and the control or police phases, and if so separated how shall they coordinate in order that results of research may benefit most advantageously? Shall we develop a certain type of entomologist narrowed down to research and another of different mentality and action to apply determined methods in control efforts?

Another great field of much promise is open to us which in its contacts with allied branches of agriculture and horticulture has been developed but slightly; viz. crop sanitation and crop rotation problems to be worked

out with the soil expert and the agronomist. Probably herein lies the greatest opportunity for cheap, valuable and reasonably constant pest control without serious interference with customary routine practice. The writer believes that preventive entomology, akin to preventive medicine, has an interesting development just ahead.

The remarkable results obtained in heat control and vacuum fumigation of insect infested goods opens up a tremendous new field, which would indicate the desirability of intermittent heat storage to replace cold storage for household goods, woolens, furs, carpets, grain and grain products, tobacco, lumber and similar dry merchandise. Who knows what recent experiments in dusting by airplane may lead to, even to the extent of gas treatment of immense acreages. The recent development of liquid cyanogen for fumigation; the highly successful paradichlorobenzene treatment for peach tree borers; the greatly belated development of casein and flour stickers; copper-arsenic dust for potatoes, and similar crops, and the rapid adoption of the alkaloid nicotine in liquid and with a dust carrier, are a few outstanding recent accomplishments of which we can be proud. Every young entomologist should have an attitude of assurance to believe that economic entomology is only in its morning hours and that he has a wonderful opportunity to aid in turning on the light to a more perfect day of accomplishment. Whereas but a few workers labored in earlier years and accomplished so much in a brief span of activity, should we not be buoyantly optimistic with high expectations when many workers shall have merged the impetus of their endeavors in entomology and closely allied subjects.

Past President Cooley: We have had the privilege of listening to a very thoughtful and interesting address.

We will now proceed with the discussion.

Mr. Wilmon Newell: It seems to me that we have received, in the President's address, some good food for thought. We can well afford, in the haste of carrying out our own plans and ideas and purposes, to occasionally pause and give thought to just such considerations as have been brought out in that excellent address. Perhaps most of us do not stop to think what next year and the year after, and the next ten years, may bring forth, either in our own lines of endeavor or the endeavors of our fellow workers in economic entomology. No one could have foreseen, a quarter of a century ago, what has actually happened in the last twenty-five years, and of course no one can foresee what will happen

in the next twenty-five or the next fifty, but we do know this—that the more difficult it is to sail a ship, the more keen are the lookouts, and we too, should be ever alert, watching for the opportunities to make our calling more useful, and to adapt it to the needs of the times, to respond to opportunities. I doubt whether economic entomology has always responded as quickly as it should, to changing conditions.

I have been very much impressed with what the President had to say about bringing our profession more into the minds of the public, of inspiring more respect for this thing that we call economic entomology and he has made a most valuable suggestion regarding the teaching of the primary sciences, including entomology, in the public schools. We all know how much easier it is to instill knowledge and respect for any subject in the minds of the children than it is to instill it into the minds of older people; and even though we smiled when he mentioned the personal appearance and habits of entomologists, it is nevertheless true that the great bulk of people form their opinions of a profession by the people in that profession with whom they come in contact. I think we can well read and reread that excellent address!

Mr. C. L. Marlatt: I wish to give my very hearty endorsement to the address. I think some of the points that made us smile are very useful points. The standing of any group of men in a community, or in the world, is in part based on their own standing with themselves. Your work should warrant self-respect, a feeling that you are engaged in something worth while, and that you are not ashamed of it, and you should live up to that feeling. I think the public takes you very largely on the measure that you give yourself, and the entomologists ought to keep that in mind.

I think we are a rather gentlemanly looking lot of men as I look over the audience. I see no long-haired men in the group, although quite a few have whiskers! (I am not looking at Dr. Howard or Dr. Felt) But there is much benefit to be had from having a reasonably good opinion of ourselves, as good an opinion as the Chairman, our President, undoubtedly has of himself—and quite properly.

As to the public's appreciation of the work of entomologists, I am not in disagreement with our President, but I feel perhaps he has underestimated the appreciation of the public of the work in ecomonic entomology. I think we have passed through the period of being unknown and sometimes unrespected. I believe the work of economic entomologists is now pretty well known and its value appreciated. In the lines of work in which I have been more particularly interested during the

last few years, in plant protection and plant quarantine, I have discovered that the knowledge and appreciation of that work is almost universal.

Acting in my peculiar capacity as buffer for all the kicks that come in, I have come across a great many people whose feelings had been hurt, but I have yet to come across a single person who has not expressed at least the realization of the need of protection from plant enemies. It is practically universal. Nearly every woman and man of the country has some appreciation of that need.

This does not mean that we are known as well as we ought to be known, but I do feel we stand well in the minds of the people of the country. If we can strengthen that status by our own attitude, our own reasonable and proper self-pride, I think it may help matters a great deal.

Past President Cooley: I am aware that we like to think over an address at some length before we commit ourselves to words. I admire the courage of the speaker in departing from stated facts and imparted knowledge and looking forward. He has stimulated thought. An entomologist should not dwell too long in the field of imagination, yet he needs some imagination to make him progress. I feel that the President's address has been very stimulating in that it directs us to look forward.

President Sanders resumed the chair.

President J. G. Sanders: The first paper on our program is "Problems in Economic Entomology," by E. P. Felt.

PROBLEMS IN ECONOMIC ENTOMOLOGY

By E. P. Felt, *Albany, N. Y.*

Abstract

The annual cost of plant quarantines for the various States is one and a half million dollars; for twenty-eight Californian Counties nearly ⅓ of a million dollars; for the Federal Quarantine Service $185,310.00 and in addition one and a half million dollars for the control of regional pests. Costs might be reduced by the adoption of a plan which would obviate reinspection. Quarantines are human and eradication of recently established insects, such as the camphor scale, *Pseudaonidia duplex*, would be a logical sequence.

The Gipsy Moth, *Porthetria dispar* is now established along approximately seventy-five miles of the eastern border of New York State. A barrier zone extending northward and westward through the highly cultivated regions from Bridgeport to Danbury, Connecticut, thence through portions of the Harlem, Hudson, Champlain, and St. Lawrence Valleys to Lake Ontario, is recommended. Projects of this character should be under the direction of experts.

Conditions at the present time are very different from those of twenty-

five years ago. At this earlier period there were a few standard insecticides which were somewhat generally recommended and if the results were not satisfactory, it was an unfortunate condition which might be remedied in the future. There had not been at that time many exhaustive studies so characteristic of the investigations of the past twenty years, and advances in relation to insecticides were largely the result of incidental work in connection with other problems, as for example the development of arsenate of lead in the Gipsy Moth control work. Large expenditures by the Federal Government for quarantine and for the control of serious regional pests were in the future.

Early in the calendar year Professor C. R. Crosby of Cornell University obtained the cost of the inspection and quarantine services of many of the States and has kindly allowed the writer to use these data. It has been found that the State officials of this country are expending over one and one half million dollars annually and officials of 28 Californian Counties nearly one third of a million dollars annually in this work. These figures do not include the cost of the Federal quarantine service, $185,310.00, nor comprehend in more than a very limited degree, the large sums, totaling over $1,500,000.00 appropriated by the general Government for the control of serious regional pests and allied purposes. Furthermore, in the western States, particularly California, large sums are spent for weed and rodent control or eradication and the standardization of fruits. These latter in a broad sense might be classed as expenditures for inspection and quarantine, though they are not so considered in this paper.

These are vast sums and one may reasonably inquire as to the results which have accrued from the expenditures. There is no question but what there has been a marked raising of Horticultural standards and that under present conditions, it is very difficult to sell trees badly infested with a number of dangerously injurious insects or infected by certain plant diseases. Furthermore, the higher standard for fruits, both in the east as well as in the west, have bettered conditions and made satisfactory returns more probable. The same considerations apply in a general way at least to importations from other countries.

It must be admitted that quarantines are human and in the long run some pests escape inspectors in spite of repeated examinations. It may be possible to improve the inspection service even if there be no other gain than a reduction in cost without affecting the degree of protection. It is well known, for example, that nursery stock is inspected at the point of origin in some States, and reinspected at destination

and in some States, such as New York, recognition of interstate law has resulted in these inspections being made at the point of destination. This means large costs inevitable with the inspection of small and widely scattered lots. Is it possible to standardize methods of inspection in the various States so that duplications of this character can be avoided? One thorough inspection should be enough and it might be possible to develop and attach to each tree a seal which could not be tampered with and would therefore be accepted throughout the usual distributional areas and if this were admitted, it might be advisable to divide the country into sections where similar stock is in general demand. Cases not readily covered in this manner could be handled about as at present.

EXPENDITURES BY STATE OFFICIALS FOR INSPECTION AND QUARANTINE IN 1921 OR 1921–1922

State	Salaries	Other Expenses	Apiary	Corn Borer	Gipsy Moth	Total
Alabama	4898.60	3376.65				8275.25
Arizona	20000.00	30000.00				50000.00
Arkansas	7280.00	3720.00				11000.00
California	40000.00	10000.00				50000.00
Colorado	in other expenses	20000.00	2500.00			22500.00
Connecticut	3549.61	4874.92	1981.70		35188.50[1]	45594.73
Delaware						
Florida	100000.00	8500.00				108500.00
Georgia	3000.00	60000.00				63000.00
Idaho	7400.00	27600.00				35000.00
Illinois	10000.00	14895.00				24895.00
Indiana	9101.90	5618.46	8372.15			23092.51
Iowa	3164.00	1887.23				5051.23
Kansas	1000.00		3000.00			4000.00
Kentucky		499.51				499.51
Louisiana	Practically no expenses					
Maine	1500.00				28500.00[1]	30000.00
Maryland	5560.00	4800.00				10360.00
Massachusetts	13000.00	10000.00			181957.92[1]	204957.92
Michigan						12000.00
Minnesota	3330.00	2220.00				5550.00
Mississippi	100000.00	67000.00				167000.00[2]
Missouri	1875.00	1875.00				3750.00
Montana	10800.00	26153.85				36953.85
Nebraska	No appropriation					
Nevada		500.00				500.00
New Hampshire	3600.00	8900.00				12500.00
New Jersey	13527.86	5721.35			5553.28	24802.49
New Mexico	No expenses, no appropriation					
New York	50000.00	50000.00		12500.00		112500.00
North Carolina	2000.00	700.00				2700.00
North Dakota	Little expense, no special appropriation					
Ohio	14200.00	10800.00				25000.00

[1]Includes control work.
[2]Includes $22,000 of Federal funds used for citrus, canker and sweet potato weevil eradications.

State	Salaries	Other Expenses	Apiary	Corn Borer	Gipsy Moth	Total
Oklahoma	3600.00	1500.00				5100.00
Oregon	2400.00	3600.00				6000.00
Pennsylvania	41850.00	23250.00	5750.00	1500.00		72350.00
Rhode Island	200.00	75.00				275.00
South Carolina	7500.00	2500.00				10000.00
South Dakota	1200.00	1300.00				2500.00
Tennessee	16900.00	15900.00				32800.00
Texas	17206.96	15666.46				32873.42
Utah	3420.00	8930.00[3]				12350.00[3]
Vermont	2000.00	2672.90				4672.90
Virginia	12309.91	6190.90				18500.81
Washington	24000.00	9000.00				33000.00
Wisconsin	8750.00	8750.00	10500.00			28000.00
Wyoming	No appropriation					
Totals	570123.84	478977.23	32103.85	14000.00		1358404.62[4]
Gipsy Moth total						251199.70[4]

[3]Apparently includes compensation of county crop pest inspectors.
[4]These totals should be increased by $125,000 each, the special appropriation in New Jersey for Gipsy Moth control and not included above.

Expenditures by California County Officials for Inspection and Quarantine in 1921 or 1921–1922

Name of County	Salaries	Other Expenses	Total
Contra Costa	$1800.00	$3700.00	$5500.00
El Dorado	1370.00	740.00	2110.00
Fresno	———	———	9000.00
Glenn	4733.75	2357.06	7090.81
Humboldt	2400.00	1200.00	3600.00
Imperial	4554.00	2214.02	6768.02
Inyo	1869.00	2150.00	4019.00
Kern	5402.50	1080.70	6483.20
Kings	2160.96	446.73	2607.69
Lake	1074.00	678.46	1752.46
Los Angeles	67864.81	17417.29	85282.10[1]
Madera	3298.25	1741.19	5039.44
San Rafael	1854.00	497.57	2351.57
Napa	2400.00	1263.10	3663.10
Nevada	2200.00	768.31	2968.31
Placer	4834.00	1452.82	6286.82
Riverside	10750.00	10750.00	21500.00
San Benito	850.00	225.00	1075.00
San Diego	13116.74	690.77	13807.51
San Francisco	4200.00	1680.00	5880.00
San Luis Obispo	625.00	600.00	1225.00
San Mateo	4000.00	1000.00	5000.00
Santa Cruz	2400.00	600.00	3000.00
Shasta	1200.00	1000.00	2200.00
Sonoma	4882.03	2034.09	6916.12
Stanilaus	18605.63	18102.20	36707.83[2]
Tulare	38284.93	18757.60	57042.53
Tuolumne	1000.00	1000.00	2000.00
	$207729.60	$94146.91	$310876.51

[1]A portion of this apparently should be charged to rodent control.
[2]Apparently about 50% of these amounts are for rodent and noxious weed control.

The above outline of expenditures by County officials is limited mostly to the expenses of inspection and quarantine, though in some instances an appreciable proportion of the cost of rodent control and other activities is included. The County Horticultural Commissioners of California expend considerable sums in standardization of fruits and vegetables, weed control and rodent control, matters receiving little attention in the eastern States, though as germane to the work as Gipsy Moth, European Corn Borer or citrus canker control in the east.

It will be noted that data have been obtained from 29 of the 51 Counties reported as maintaining Horticultural Inspectors who have the direction of approximately two hundred County Inspectors.

The Horticultural work of the State of Colorado is carried on in cooperation with County Pest Inspectors who are employed and whose expenses are paid by the several Counties in which the work is done. The amount expended by these County officials has not been ascertained on account of the difficulty of obtaining the data.

Reference has been made to the fact that quarantines are not perfect and in this connection we would suggest the desirability of methods which would result in the early detection and extermination, if advisable, of insects which have escaped the vigilance of quarantine officials. One of the practical difficulties with such a proposal is the impossibility of being certain that the recently established insect will prove sufficiently destructive in the environment to warrant the costly measures necessary for extermination. It would seem as though the recently established camphor scale, *Pseudaonidia duplex* Ckll., in view of the history of the San Jose scale in America, might be classed as one of those pests which should be exterminated.

We have at the present a similar, though somewhat different problem, pressing for solution in the northeastern United States. I refer to the presence of the Gipsy Moth along approximately 75 miles of the eastern boundary of New York State and to its threatened spread over a large area if matters are allowed to follow the course of the last few years. There is no denying the fact that the Gipsy Moth is a serious enemy of forests in the temperate regions of this country and if the spread of this insect is allowed to continue, it is only a question of time before the border of the infested area becomes so extensive as to make it nearly impossible to check further spread.

Can we afford, as Entomologists conversant with the situation, to allow matters to drift in view of the fact that the possibility of exterminating this insect in remote infestations and under distinctly adverse

conditions has been demonstrated time and time and again and in consideration of the fact that those best acquainted with the pest do not hesitate to state that it is clearly practicable to prevent further spread? The border of the infested area is now stretching toward a highly cultivated region with a minimum of rough, forested ground and in view of such unusually favorable conditions for checking spread existing from Long Island Sound northward from Bridgeport, Connecticut to Danbury, thence to the Harlem Valley in New York State and northward and westward through the Hudson and Champlain Valleys and thence westward along the New York border to Lake Ontario, we would seriously suggest the advisability of actually preventing further spread beyond some such line, because such limitations would mean freedom for at least a series of years for all territory to the west. In other words, this means the application of exterminative measures to a strip instead of to a circumscribed area.

We would also call attention to the fact that the total expenditures in Massachusetts in 1921 for control of the Gipsy Moth in the then infested area, probably less than three-fourths of the total area of the State, amount to the tremendous sum of $836,108.40 according to figures compiled under the direction of the Massachusetts State Forester, William A. L. Bazeley and kindly placed at our disposal. Should the entire State of New York become infested and the same ratio prevail, the annual cost for suppressive work in the State would exceed five and one-quarter million dollars. It should also be noted that in 1897 and again in 1899 the late Professor C. H. Fernald, then Consulting Entomologist of the Massachusetts State Board of Agriculture, which latter was then in charge of the Gipsy Moth work, estimated the cost of exterminating the Gipsy Moth at $1,575,000.00, the work to be continued over a period of fifteen years.

Briefly, this was an estimate which had the approval of experts engaged in the work, the men by all means best qualified to pass upon the situation. The project was allowed to lapse, the opinion of experts was set to one side and as a consequence the total cost to all agencies in the infested portions of the State of Massachusetts, comprising far from the entire area, amounted in 1921 to more than half the total estimated cost of extermination in 1897 and that for what was really unsatisfactory control. As a further consequence the State of New York is threatened with heavy annual expenditures because of an insect which could have been exterminated and should not have been allowed to escape.

The setting of the opinion of experts to one side is a grave phase of the situation. Our Entomology is economic only in proportion as it is carried out. It is comparatively easy to start a program of extermination and this was done in Massachusetts in 1891. The weak point came with the development of the work to such an extent that little was to be seen of the insect and a popular verdict was given against continuance of operations.

There has been, as intimated above, a vast increase in our knowledge of insects and methods of controlling them during the past twenty-five years. It may reasonably be claimed that American Entomologists are a group of experts best qualified to pass upon insect problems. The speaker is of the opinion that whenever a representative group of qualified Entomologists agree upon a policy, such policy should receive the support of executives, unless said executives are willing to accept the responsibility for inaction or modification. The great metropolitan water system of Massachusetts and the huge water supply projects of New York City were all planned and directed by engineers,—men preeminent in the branches of science relative to such matters and in making the above statements, the writer is simply emphasizing the need of similar action in relation to Entomologists if the country is to secure the full benefit of their services.

President J. G. Sanders: Is there any discussion?

Mr. W. C. O'Kane: I only wish that Dr. Felt had taken more time and had gone further. He has begun a discussion of an important problem. We have had this subject before us incidentally at the last two or three meetings—this subject of what we might call "entomological engineering." Personally, I am convinced that it is a wide and important field and I am inclined to think that in spite of all of our needs for research, in spite of its importance and its fundamental value, there is an almost equal need for the kind of undertaking that he has mentioned.

President J. G. Sanders: The next paper is "Choice of Food and Numerical Abundance Among Insects," by C. T. Brues.

CHOICE OF FOOD AND NUMERICAL ABUNDANCE AMONG INSECTS

By Charles T. Brues

Abstract

Insects are not alone in almost unlimited capabilities for rapid multiplication, the limiting causes being prevalence of disease, parasites and available food supply. The remarkable instincts associated with the choice of food plants have been largely neglected by investigators. Certain insects like the migratory locusts are highly polyphagous, while others are limited to a single food plant, probably through a long evolutionary process. Agricultural pests may be either polyphagous, oligophagous or monophagous and under primitive conditions the former were represented by larger populations than those with more restricted diets. Only very exceptionally do natural associations of plants offer ideal conditions for monophagous insects, as in western coniferous forests and certain types of grasslands some oligophagous species are apparently composed of several phytophagic races propagating more or less independently. Species exhibiting remarkable capacity for shifting from one food plant to another, such as the cotton boll worm may become extremely abundant where its food plants are associated, though natural checks soon establish an approximate balance as a rule. Trees and plants with a long life cycle occupy a relatively insecure position with regard to insect damage.

In their almost unlimited capabilities for rapid multiplication, insects do not stand alone among animals, although the economic entomologists may sometimes be tempted to categorize them thus. That many insects frequently approach more nearly the mathematical possibilities in their actual population growth than do the vertebrates or even the more conspicuous other invertebrates is, nevertheless, quite true, and the main contributing causes for this are naturally familiar to the entomologist who is periodically confonted by outbreaks of noxious insects.

That we may not become too pessimistic concerning the abundance of insects, several entomologists have been guilty of counting the prospective progeny of a happily married and economically independent pair of insects, able to protect and provide for their descendants during a single season. No less an authority than our fellow member Dr. Howard assures us that an April bride of our common housefly under such ideal conditions would not be able in the autumn to enumerate her great grandchildren of the fifth generation with less than 13 figures. He further concludes that a really prolific strain of houseflies might produce a far more extensive family. At that time it did not occur to him that even the smaller family, dried and pressed into briquettes, would furnish nearly 20,000 tons of a very good substitute for coal, all the product of the insignificant fly born at the season of the year when the provident members of human society were filling their cellars with anthracite.

It is of course patent that the numerical abundance of a great many species of insects, perhaps of nearly all, depends to a very limited extent upon their powers of reproduction and almost entirely upon the factors which tend to limit these powers. Among these, the prevalence of disease, of insect parasites and the extent of the available food-supply are the factors that determine how far any species may utilize its latent powers for reproduction and multiplication. All three factors are highly variable and to one or the several in combination may usually be traced the numerical abundance of any particular species. Entomologists have devoted so much effort toward elucidating the relation between host and parasite and the balance between insect and food-plant, that a detailed knowledge of such facts is generally recognized as a fundamental prerequisite for the formulation of control measures directed against agricultural pests.

In spite of its basic importance in determining the economic status of phytophagous insects, the remarkable instincts associated with the choice of food-plants have been largely neglected as a field for investigation by economic entomologists, due, no doubt, to the pressing demand for information of more immediate application.

We know for example, among economic insects of importance that some like the various migratory locusts are so highly polyphagous that they balk at practically no type of green food (even paris green and molasses), while others like the cotton-boll weevil not only refuse, but seem actually unable to subsist upon any but a single food plant. These two extreme cases suggest that primitive omnivorous insects may have become specialized through a long evolutionary process and have produced among the higher orders first species with restricted diet and finally ones of strictly monophagous habits. Such an assumption is, in a very broad way, probably correct, but it does not take into account the intimate mixture of polyphagous, oligophagous and monophagous species to be found in almost any phytophagous division of the higher orders of insects. The familiar large Saturniid moths furnish a concrete example: the caterpillars of the Cecropia moth are credited with sixty-odd food plants, some of course more favored than others, while those of the closely related Ailanthus moth are restricted to the ill-smelling foliage of the Tree of Heaven, and the Eri silk moth selects almost exclusively the leaves of the castor oil plant. What the reason for such divergencies may be, or whether the Eri caterpillar like the Kansas grasshopper would prefer its castor oil with orange juice, I shall not attempt to predict in the absence of the proper experimental data, but I wish to

call attention to some facts relating to the numerical abundance of some other insects of the several types just mentioned.

It is evident after a moment's consideration, that destructive agricultural pests, or in other words, numerically abundant species that feed upon useful plants, may be either polyphagous, oligophagous, or monophagous. Under natural conditions as they existed before agriculture changed the face of nature, there can be little question that insect species of polyphagous tastes were represented by larger populations than those affecting more restricted diets for it is only under very exceptional conditions that natural associations of plants are sufficiently dominated by a single species of plant to offer ideal conditions for the multiplication of monophagous insects. Such notable exceptions are illustrated by some of our western coniferous forests and by certain types of Savannahs or grass-lands where the dominance of one or of several species is almost complete, more nearly so indeed than in the average potato patch. To natural associations of plants, common migratory locusts are about as destructive as to cultivated areas. The non-migratory forms we cannot legitimately compare in this connection on account of the destructive action caused by plows and harrows to their eggs in cultivated fields.

Under natural conditions oligophagous species sometimes enjoy the presence of their several food-plants in close proximity over more or less extensive areas, but much more commonly they do not, for it is by no means the rule to find the several food plants of such species occurring in the same associations of plants. Rather does it appear that at least many oligophagous insect species are composed of several phytophagic races as Walsh termed them many years ago. In reference to the species as a whole these races appear to bear a relation analagous to the pure and impure species of the geneticist and in many cases at least the phytophagic races propagate themselves more or less independently of one another. Races of this sort are exemplified by the apple-maggot and blueberry-maggot (*Rhagoletis pomonella*), the codling moth of the apple and of the walnut (*Cydia pomonella*), the mangold-fly (*Pegomyia*) and others. Such species, so far as numerical abundance is concerned, do not appear to profit by their ability to feed on more than one food-plant as they do not shift readily from one to another. On the other hand, at least one of our very important economic insects has been able to capitalize its fondness for several agricultural plants. This is the cotton bollworm, an insect which has become numerically abundant under the agricultural conditions now prevailing in our southern states. As

is well known to every one present, the larvæ of this moth have two very favored food-plants, maize and cotton, several less favored ones such as tomato and tobacco and a number of others to which they will quite readily transfer their attention with practically no persuasion. Maize is undoubtedly the most favored food, but no strains have been developed preferring maize or cotton respectively and this is undoubtedly due to the seasonal distribution of the parts of the plants attacked, namely the unexpanded tassels and soft ears of maize and the buds and green bolls of cotton which follow one another during the growing season and offer a continuous but changing food-supply not only to the several broods each summer, but regularly from year to year.

Species exhibiting such plasticity in their behavior tend to become extremely abundant where their several food-plants are associated, and the species just cited has been favored by an unusually happy combination of circumstances. If we apply such a principle to another insect like the cabbage maggot (*Pegomyia*) it is evident that this species should be able in the ordinary truck garden where cabbages and a succession of radishes are grown, to avail itself of a continuous supply of succulent food. In connection with this species, I am not aware, however, that any investigations have been made to ascertain how readily the flies shift from one food-plant to another in successive generations, and the studies of the English entomologist Cameron on related species suggest that the cabbage maggot may have phytophagic varieties or strains, which tend to remain from generation to generation on the same food-plant. So far as oligophagous forms are concerned, it is evident that aside from the mere existence of several acceptable food-plants, the numerical abundance of each species is influenced not only by the proximity of the several food-plants, but by the ease with which a shift is made from one favored food-plant to another; and furthermore that all insects do not react similarly when the opportunity for a change of food-plants is presented to them.

The Oligophagous habit passes by close intergrades to the monophagous type of feeding. Frequently the difference is only apparent and due to incomplete knowledge as has been often demonstrated. Again it is easily conceivable that the areas occupied by the several food-plants may be separated geographically, in which case the strains feeding on one plant will never have opportunity to pass to another and may become so wedded to this food that they will refuse to leave it. On the other hand as is well known from the behavior of certain introduced insects a sudden taste may be shown for a strange, though usually

closely related plant. Some recent experiments of my own with the Colorado potato beetle show this type of behavior very clearly. This insect will feed upon various species of Solanum belonging to two of the five sections into which the genus is divided; at least several of the species referred to the section that includes the original food-plant (*S. rostratum*) are readily accepted, as well as our common bittersweet (*S. dulcamara*) which falls in another section, that to which the potato belongs. The bittersweet and a large spiny African plant (*S. marginatum*) attract the beetles even when planted in close proximity to the potato. The ordinarily monophagous habit of the potato-beetle is thus clearly due to the composition of the flora and any significant change in the latter must have its effect upon the numerical abundance of the beetles, particularly on the population living at the expense of its economic food-plant the potato, which is planted from year to year without reference to the abundance of the beetle, while the supply of its uncultivated food-plants varies inversely with the prevalence of beetles.

Just as the supply of the food-plant necessarily limits the abundance of the insects dependent upon it, so the number of insects competing for subsistence upon a single kind of plant influence one another greatly. Such competition does not however, lead to such a strict "survival of the fittest" and "elimination of the unfit" as theoretical considerations might lead us to believe. Several entomologists who have during recent years compiled lists of the insect faunæ of dominant species or genera of plants under both natural and agricultural conditions, have been able to find long series of insects affecting almost any plant which they care to investigate. In more or less circumscribed areas these series of insects come into direct competition with one another when they depend upon the same part of the plant, such as the foliage, although indirectly all interfere with one another; even such diverse kinds as Aphids, defoliators, leaf-miners, stem and root-borers, etc. Under prevailing non-agricultural conditions, this competition is so much less keen than that between host and parasite that a phytophagous insect appears rarely or never to be actually threatened with extinction or even decimation by any failure of the food supply resulting from the ravages of competing species. It must be understood fully however, that I should by no means wish to imply that such competition extending over long periods of time might not readily lead to vast changes in both fauna and flora. Just as an extensive outbreak of some phytophagous insect like the American tent-caterpillar with its accompanying epidemic of parasites and other enemies may lead to the complete local ex-

tinction of the host, so might an insect become numerically so abundant as to annihilate its food-plant. Before the latter contingency threatens, however, the background of entomophagous parasites comes to the fore and saves the day for the plants.

Trees and other vegetation of slow growth, where the developmental cycle extends over a period of years, occupy a more insecure position than their annual or biennial relatives, and are unable to take the same advantage of any temporary reduction in the ranks of their insect enemies. Nevertheless here too, the quick response of parasites to an increased abundance of their phytophagous hosts ordinarily effects a readjustment in numerical abundance before an extensive depletion of food-plants takes place. Thus, in France Clement finds 450 insect enemies of the willows and Coulon 1,400 species affecting oaks, all so regulated by parasites that they do not crowd out one another, nor do they eliminate their food-plants during the twenty-odd years required for the individual oaks to attain sexual maturity.

Excessive outbreaks of forest pests, however, do occur; witness the larch sawfly, spruce budworm and the Gipsy moth in their native habitats, resulting in a prolonged depletion of food-plants over wide areas.

One of our lessons of early childhood attempted to teach us that "we cannot eat our cake and have it too." This was necessarily impressed upon us by firm parental persuasion. A wider biological application of this adage must introduce the term "parasitic persuasion" to designate the Spartan method adopted by Nature to conserve the cake.

President J. G. Sanders: We will now have a paper by Mr. A. G. Ruggles and S. A. Graham, entitled "The Obligation that Economic Entomology owes to Forestry."

THE OBLIGATION THAT ECONOMIC ENTOMOLOGY OWES TO FORESTRY[1]

By S. A. Graham and A. G. Ruggles, *Division of Entomology, University Farm, St. Paul, Minn.*

Abstract

Forest Entomology has been neglected as compared with insects affecting other crops, despite the enormous losses in our important forest areas. The entomologist has inclined to the belief that forest insects can not be controlled and the forester has

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usually received more or less impractical advice. The spruce bud worm, the forest tent caterpillar and the larch sawfly are major insect problems as well as the control of pests attacking freshly cut timber, particularly pulp wood. The general effects of poisoning forest areas should be investigated. The method presumably can be used only to a limited extent. A study of ecological relations and the development of improved silvicultural methods is advised.

All of us who are working in the various phases of entomology recognize that economic entomology exists for the express purpose of organizing and directing man's fight against his insect enemies. It is apparent to anyone acquainted with agricultural conditions that if it were not for the efforts of the economic entomologist in devising and applying measures for the control of injurious pests, the chance of success for agricultural operations would be even more uncertain than at present. We must, of course, admit that there are still many uncontrollable insect pests, but when we consider the large number of species that can be sucessfully controlled we should feel decidedly encouraged.

Results always speak for themselves! Therefore no one can doubt that the entomologist is using every means in his power to solve the problems of both the farmer and the horticulturist. His efforts along this line have been rewarded with success; remarkable success when the odds against which he is fighting are taken into consideration. A large proportion of our extremely serious farm and orchard insects can be more or less satisfactorily controlled. In this connection we think of such outstanding entomological successes as the control of the Hessian fly by a slight change in time of planting, the development of arsenical poisons for the control of the Colorado potato beetle, of the use of lime sulphur and miscible oils for the San Jose scale, the development of poisoned baits for grasshoppers and cutworms, the power sprayer which made possible a satisfactory attack on the codling moth, the high power sprayer combined with special nozzles for protecting our town and park trees from the ravages of such unwelcome guests as the gipsy moth and the elm leaf beetle. And so we might go on enumerating milestone after milestone in our rapid advance in the control of farm and horticultural insects.

But the entomologist is not yet satisfied. He continues to bend his efforts toward the improvement of control measures and toward the discovery and application of means for checking the ravages of those insects which cannot be controlled at present. Think of the time and energy that some of our best minds are devoting to the gipsy moth, the European corn borer, the Japanese beetle, and the Mexican bean weevil problems. Without question such efforts must be rewarded.

But have we not been neglecting one field of economic entomology that is surely deserving of more consideration than it has received? That is the field of forest entomology. A handful of men have given their lives to this phase of insect work but their numbers have been so few and the problems with which they were confronted have been so tremendous that they are only now just beginning to make real progress. Most of the so called forest entomological work has not been conducted by economic entomologists interested primarily in forest problems, but by a group of men whose primary interest lay in other directions. These men for one reason or another were led to take up forest entomology as a side issue. Very naturally their work has been largely along the lines of taxonomy and life histories and they have made valuable contributions to these phases of the subject. Unfortunately, these workers set the fashion for forest entomology workers. Under such conditions is it any wonder that so few forest insects can be controlled? The farmer and the horticulturist have their insect insurance in the form of effective and economical protection methods, but the forester in spite of his dire need is left to gamble with fate and take his chances with insect pests of which he knows little or nothing.

The destruction of trees does not seem to disturb many entomologists. As a rule they are able to look with placid equanimity upon the wholesale destruction of vast forests. Losses which would have awakened the whole country to action, had they been in farm crops have been passed almost unnoticed. What forest insect has ever created half the excitement among entomologists as has the recently introduced pest, the European Corn Borer? If the gipsy moth had been primarily a forest insect would there now be a gipsy moth laboratory?

Were economic entomologists much disturbed when the outbreak of the larch sawfly destroyed over 60 percent of the merchantable tamarack in the vast area extending from Minnesota eastward to the Atlantic coast? A few entomologists made a good beginning in the study of the problem but we are still in no better position to control or prevent the next outbreak, which is sure to come, than we were in 1905. From estimates in Minnesota it appears that in this state alone the larch sawfly killed tamarack equivalent to over 1,000,000,000 ft. board measure, and almost 50,000,000 posts, poles and ties. At present stumpage rates this represents a cash loss of approximately $5,000,000.00 for the state of Minnesota. The loss in the entire range of the eastern larch can only be a matter of conjecture but doubtless it totals many millions of dollars. Considering the vast extent of the range of this

tree and considering the fact that the sawfly outbreak extended throughout this entire region, we are forced to concede a total loss amounting to at least $100,000,000.00.

The present outbreak of the spruce budworm in eastern Canada, Northern New England, and Minnesota has destroyed an almost unbelievable amount of timber. Before this outbreak has subsided the loss for the whole infested area will doubtless amount to at least 200,000,000 cords of standing woodpulp. This amount of wood, piled in cords with the end of each cord touching the next, would extend more than five times around the earth. At an average stumpage price of $1.00 per cord, which is doubtless too conservative a figure, the loss due to the budworm will equal $200,000,000.00. In Canada the Entomological Branch of the Department of Agriculture has devoted much effort to the study of this insect, but what have we done in this country?

During the two decades from 1905 to 1925 the loss in forest products resulting from these two outbreaks, the sawfly and the budworm, will amount to a combined total of at least $300,000,000.00 or an annual loss of $15,000,000.00. The history of forest entomology in this country has been marked by a series of outbreaks. One after another pests have become epidemic and the epidemics have waned. To the losses from epidemics we must add the normal annual loss occasioned by the hundreds of pests whose injury may be less conspicuous but none the less real. The basis upon which this loss is usually estimated is 10 percent of the total value of all forest products. According to the 1920 census figures, which are the latest figures available, the total value of forest products in 1919 was $2,420,000,000.00. Ten percent of this amount is $242,000,000.00. In Minnesota alone during 1919 the loss due to forest insects including budworm losses totalled at least $7,500,000.00. Is it right that we should shut our eyes to these losses? Should we not devote our energies to solving the forester's problems as well as those of the farmer and the horticulturist. Do we not in our position as entomologists owe just as much to forestry as we do to other branches of agriculture? Some may point to funds which have been expended for the study of forest insects and say that entomology is fulfilling its obligation to forestry, but where are the results?

THE ATTITUDE OF THE ENTOMOLOGIST TOWARD FOREST INSECT PROBLEMS

The attitude of the entomologist toward the forest insect problems which he has been called upon to solve has had much to do with bringing about the unfortunate condition in which forest entomology finds itself

today. For years the entomologist has attacked forest insect problems with the well established conviction that insect control under present forest conditions is practically impossible. He does not really expect to control forest insects until such time as forest trees in America are as carefully cared for as they are in the most highly developed European forests. His work with farm and horticultural insects has led him to exaggerate the place of our mechanical means of insect control and if spraying or some other such method cannot be applied he is prone to say in a most hopeless tone "then what can we do?". We are all equally culpable.

ATTITUDE OF THE FORESTER TOWARD ENTOMOLOGY

Is there any wonder that the forester looks askance at entomology. He has come to think that the entomologist is either unable to help him or else is uninterested. He finds that most of the suggestions which the entomologist gives him are impractical. It is natural that he should conclude that to call upon such a source for help is useless. Forestry has no constructive plan for the protection of forests from insect attacks, not because it is not sadly needed, but because the entomologist has usually been unable to make any practical suggestions for such a plan. Therefore the forester calls on the entomologist for help only after all other means have failed.

The entomologist then answers the call and investigates the situation, but what does the forester get. He gets a report. Sometimes a voluminous piece of literature with figures, plates, and tables. The content of these reports has become so well established that one can almost unfailingly predict its general character. It will start out with a discussion of the importance of the outbreak, and perhaps a little historical data regarding the insect in question. Then follows descriptions of the various stages with figures, preferably colored. Next comes the life history in detail in which the most personal affairs of the insect are disclosed and finally comes a section headed control.

Under control there will be something like this. "Unfortunately under our present forest conditions it is impossible to control this pest. If sometime in the future economic conditions so improve that we can expect a much larger return per acre from our forests and can therefore spend much larger amounts in cultural practices we may be able to suggest something that the forester can afford to try. At present we are forced to let things take their course much as it pains us to do so." *The very thing that the forester needed most the entomologist did not give him.*

PROBLEMS IN FOREST ENTOMOLOGY WHICH SHOULD BE SOLVED

In the United States as a whole there are hundreds of forest entomo-

logical problems crying to be solved. The scope of the present paper will only permit us to mention a few that are of particular importance in Minnesota. The most outstanding of these is the problem of protecting our balsam and spruce forests from outbreaks of the spruce budworm.

The outbreak in Minnesota has already involved the greater portion of our balsam spruce forests and it is practically certain that the small uninfested area in the northeastern tip of the state will be infested in 1923. A very large proportion of the balsam in at least two-thirds of this area is already dead. There is every indication, that under present conditions we may expect repeated outbreaks of the budworm every thirty to fifty years. Is there not something that we can do to prevent recurring epidemics of this insect or if that is not possible can we not at least find some way of reducing the amount of damage?

Another defoliating insect which seems to be of increasing importance in this state is the forest tent caterpillar. Recently there have been several rather extensive local outbreaks of this pest. Although they have not reached proportions comparable with that of the spruce budworm they are nevertheless important. The ever increasing amount of birch and aspen forest is apparently a factor in aiding the rapid increase of the tent caterpillar. It is very probable that this insect will be from year to year increasingly important in our forest economy.

The larch sawfly although the epidemic is decidedly on the wane, is still a menace to be reckoned with. Tamarack on well drained soil grows very rapidly and in such situations promises quick returns when grown for posts and poles on a short rotation. The planting of this very desirable species cannot at present be recommended because of the possible danger of sawfly attack. The sawfly question is still a very fertile field for investigation, and it certainly does not present any greater difficulties than many of the problems already solved by entomology.

One of the very live issues in forest insect work is the control of pests in freshly cut timber, particularly pulpwood. Much of this material is always held over a season for one reason or another and, if it cannot be placed in water, the losses due to borers is very material. It has been stated that the usual depreciation in a pile of pulpwood held over one season amounts on the average to 10 percent of its value. This means a depreciation of about one dollar a cord. We are now working on this question and hope to have soon a practical method of materially reducing these losses.

METHODS OF ATTACKING THE FOREST ENTOMOLOGICAL PROBLEM

The difficulty of a problem in forest entomology is directly proportional to the distance between the wood or tree and the finished product. We can afford to spend more in protecting material at the mill than could be spent on the same material in the woods. We can spend more on cut timber than on standing timber. The nearer a tree approaches commercial maturity the greater its value and the more we can put into its protection. During their early years the trees must practically be left to take care of themselves, since a good profit on the final crop can be wiped out easily by compounding interest even on small injudicious expenditures in the early years of the rotation. When these facts are considered it appears probable that insect problems connected with forest products are likely to be the simplest whereas those connected with young trees are likely to be the most difficult. This is borne out by the fact that many of the problems connected with the control of insects in forest products have already been solved. In this work mechanical means of one kind or another are usually resorted to with more or less satisfactory results. Therefore let us turn our consideration to that phase of forest entomology most neglected, that is the control of insects attacking living trees.

There are two distinct angles from which insects infesting standing timber may be attacked. These are, first from the point of view of checking outbreaks after the insects have actually become active and, second, the prevention of outbreaks.

Checking active outbreaks of insects must necessarily depend very largely on mechanical methods of control. Our outstanding examples of the successful checking of outbreaks are to be found in the operations against the Dendroctonus beetles in the West. These operations have been expensive and difficult, but the protection of valuable standing timber has doubtless justified the outlay of time and money. In checking epidemics of leaf eating insects we are at present almost helpless. Spraying or dusting forests with poisons has been considered impractical if not impossible and this is almost the only means that economic entomology has devised which has even the slightest chance of being applied in forest work. Recently experiments in Ohio and in New England have demonstrated the possibility of spraying areas of considerable size by means of a dusting machine attached to an airplane. By this method the work can be carried on very rapidly and with a cheap poison the cost might be brought within the realm of possibility. But it has yet to prove itself economically practical for forest work.

Even though the economical application of poison to forest areas proves a practical possibility we still know little or nothing of the effect that the extensive application of a poison would have upon forest life in general. The trees, the underbrush, and the ground would be unavoidably covered with poison dust. Considerable quantities of poison would certainly fall upon the surface of the lakes and streams, and still more would be washed into such waters by rains. What will be the effect of this poisoning to fish and other aquatic life? How will beneficial insects such as parasites and predaceous forms be affected by the treatment? Since birds feed largely upon insects, what will be the effect upon bird life in the sudden reduction of their food supply? Will the game or the small mammals inhabiting the forest be injured by the poison? In applying such methods of control we must remember that trees are not the only things of economic importance in a forest. We must also remember that the maintenance of the biotic balance within a forest reduces decidedly the chance that any pest will become epidemic. It is decidedly possible that dusting operations once started might so upset this desirable balance of environmental factors that yearly treatment would be necessary and cause in the long run more harm than good. At any rate, even though the airplane did furnish an economical means of application, and even though a cheap and effective poison could be found in sufficient quantities to make wholesale application a possibility, we must certainly answer to our own satisfaction the above questions before a general policy of poisoning for forest insect control can be safely advised.

Even at best mechanical methods of forest insect control are always expensive and at present can only be used under particularly favorable conditions; so unless we can find some cheaper effective means than those at present available it is difficult to see how we can ever expect to get really satisfactory results from the use of such methods. After insects become epidemic in a forest we are almost forced to use some mechanical means if they are to be checked at all. Therefore let us consider the possibility of limiting or actually preventing insect injury to the trees by the proper management of our forest lands, that is to say, silvicultural control.

This is a very recent development in forest entomology, but there has been enough work done along this line to show decided possibilities. In fact it shows us a way to check the losses due to forest insects without materially increasing the cost of producing lumber. It has already

proved the solution of several problems which appeared at one time to be impossible of solution.

About the first work of this sort to be published was that of Craighead on the locust borer. Previous to the publication of his bulletin almost every state in the range of the black locust as well as the federal department had its publication, dealing with this insect. Not one of these many publications could suggest any practical means of reducing the losses in forest plantings of this tree. Craighead put two and two together and found a simple and practical remedy which adds very little to the cost of growing locust posts. He found that by planting in such a way as to shade the trunks of the growing trees either by shadows cast by the trees themselves or by other trees that the injury due to the locust borer is reduced to a minimum. This same principle applies to a number of injurious borers such as the bronze birch borer, and the two lined chestnut borer, neither of which will attack trees growing in a close stand.

Another insect that can easily be controlled by a silvicultural method is the white pine weevil. Several years ago one of us determined that in fully stocked stands of white pine the injury caused by this insect was a negligible matter. At that time the recommendation was made to plant 6′ x 6′ in Minnesota and 5′ x 5′ in the east. If openings caused by the dying out of trees are kept filled by replacement plantings we can be certain of a final crop of straight merchantable trees. Recently Peirson, working independently of any knowledge of this previous work has come to essentially the same conclusions.

In the budworm infested area the balsam is not injured to the same degree in all stands. In the same locality and under similar conditions of soil, elevation, and exposure we frequently find some stands with 100 percent dead balsam and others with less than 50 percent dead. It is evident that in the area where less than 50 percent was killed that some factor or factors had a decided effect in checking the budworm. It seems quite probable that such stands would never have suffered at all from budworm injury had it not been for the excessively heavy infestation in surrounding stands. From the comparison of sample plots in the infested region it appears that the seriousness of budworm injury is related to the composition of the forest. Generally speaking the mixed stand of balsam fir, spruce, and hardwoods is much less susceptible to injury than is the pure or nearly pure stand. The injury is directly proportional to the percentage of balsam fir in the stand. This

fact indicates very strongly that the control of the spruce budworm is possible by the use of silvicultural methods.

It is certain that outbreaks of injurious insects are just as much the result of the operation of well defined natural laws as is any other natural phenomenon. When a certain amount of heat is applied to water it will boil, if the heat is taken away it will cool. Certain factors bring about the changes in the biotic balance in a forest and as a result we have certain species favored at the expense of others. When the favored species is an injurious insect we have an epidemic of the pest. It seems reasonable to believe that if we had more knowledge of the factors involved in bringing about or preventing outbreaks that we might easily reduce the chance of the occurrence of insect epidemics.

A PROGRAM FOR FUTURE PROGRESS IN FOREST ENTOMOLOGY

As already pointed out, the problems of forest entomology divide themselves into two groups: 1, those involving the protection of forest products and 2, those involving the protection of growing timber. Mechanical means are usually available and more or less effective, in the first group, but in the second group the mechanical methods are only economically applicable under particularly favorable conditions. Therefore we must largely turn to silvicultural control for insect pests of growing forest trees.

To confine our attention to the development and application of mechanical methods wherever they can be applied has been the tendency in the past but the time has now come to turn our attention also to the development of silvicultural methods. We can no longer be satisfied with taxonomic and life-history studies of insects in our forests but we must also find some means of controlling these pests. We can no longer avoid the issue by telling the forester that we will help him as soon as he has changed economic conditions to suit our established methods of insect control. We must accept economic conditions as they are and if our old control methods do not fit we must find new methods which can be used. We have already found some encouragement in this new child of forest entomology, silvicultural control. Let us develop this phase of the work and watch it lead us to successes far in excess of our fondest hopes.

Secretary A. F. Burgess: Although I did not hear all of this paper, it seems to me that in addition to the suggestions made, there is need for a more thorough study of natural control agencies and the utilization of natural enemies on some of these problems. A more intensive study

on that phase of forest entomology would give knowledge that would be of great importance and value in assisting in control work.

Mr. E. P. Felt: I would like to emphasize, in connection with the control of leaf-eating insects in forests, the desirability of securing better protection of bird life. Of course that will not remedy the situation next week or next month. There have been figures published within recent years showing a material reduction in bird life, and as I have studied the situation in New York State, it has seemed to me that there has been a connection—not perhaps very close—between that and a perceptible increase in the ravages of leaf-eating insects.

Another point in this connection, is this: I imagine most entomologists of this country do not realize that in Massachusetts at the present time there are practically no efforts to control the gipsy moth in ordinary woodland areas, and if that situation is allowed to continue, it is going to be practically impossible to grow trees to timber size in areas infested by the gipsy moth. Think of what this will mean, particularly in this country, as we are facing a serious timber shortage, destined to become more acute as the years progress.

President. J. G. Sanders: The next paper is by W. H. Brittain, entitled "Some Experiments in the Control of the Cabbage Maggot."

SOME RECENT EXPERIMENTS IN THE CONTROL OF THE CABBAGE MAGGOT (*CHORTOPHILA BRASSICAE* BOUCHE)

By W. H. Brittain, *Provincial Entomologist for Nova Scotia*

Abstract

Experiments with a number of compounds for the control of the cabbage maggot, *Chortophila brassicae* for a period of eight years have shown that considerable latitude in the use of corrosive sublimate is allowable and that even under adverse weather conditions there is no necessity of applying the treatment until several days after the flies appear. It has also been demonstrated that the application remains effective for some time; the same is true of treatments with creosote or anthracene oil dust, though not to the same extent.

During the past eight years experiments in the control of the cabbage maggot have been carried out by the Entomological Division of the Department of Agriculture of Nova Scotia. During this time many methods and materials for the control of the cabbage maggot have been tested. During this period some of these have proved worthless, some have given fair results, while, of those that have given invariable satisfaction, four have survived to be included in the 1922 tests.

It has been our custom in these experiments to run three series of plots. Any new or untried material is thus placed first in our "trial plots,"

where it is tested on a comparatively small scale and with few duplicates or repeatings. Here, if it shows promise, it is promoted next season to the "continuation plots" where it is tested on a larger scale and usually duplicated at least ten times. If in the continuation plots it gives evidence of possessing undoubted commercial value, we endeavor to have it tested according to our instructions by a commercial grower. Two of the treatments that we have used have reached this latter stage and of these one of each have been given an adverse report by one of those who tested it—one of these was an official entomologist and one the director of an experiment station. All the commercial growers secured excellent satisfaction from both treatments.

These four treatments have all been tested in our continuation plots for at least three years and accordingly, we have prepared a table showing the average results for these three years, which should show better than a single year's figures the comparative standing of the different treatments.

In considering the factors that affect the price received we have to consider not only total weight, but also earliness of maturity. The latter is affected by certain treatments or lack of treatment and it is the treatment that produces the greatest weight of earliest maturing cabbage that, as a rule, brings the best price, because the greatest price is usually received for those cabbage that reach the market first. We have based our comparison of the different treatments mainly on the weight of head secured, primarily because we sell by weight, but also because it is the only really quantitative way to record results. If sufficient duplicates are employed to minimize variations in soil, moisture conditions, etc., it undoubtedly gives the most accurate idea of the comparative value of different treatments. Along with the total weight of head we consider the actual price received from the cabbages from each plot, careful records of which are always kept. This is the most practical standard of comparison and the one that has the greatest interest for the commercial grower.

In considering these results it should be noted that with the creosote and anthracene oil dusts, we have used ordinary clay as a filler. All the treatments were applied twice except the tobacco dust-corrosive sublimate mixture, which only received a single application. The first of these applications was made when the flies first appeared, the second a week to ten days later. It should further be noted that all the plants were grown under the very best cultural conditions and consequently

there was less actual loss as a result of the insect's work than would have otherwise been the case.

In comparing these results one with the other and with the check plot, it will be seen that we have here four treatments that give results that can be considered as good commercial control. The difference between them is not so great that it cannot be explained on the basis of experimental error. It is the opinion of the writer, however, that over a longer period of years the different treatments will stand in order of effectiveness about the same as in the table.

Cabbage Maggot Continuation Plots
Average of 3 yr's. Results
2250 plants per treatment; 14520 plants per acre

Material	Strength	Per cent Destroyed	Weight Harvested (lbs.)	Price Received	Net Profit per Acre
Corrosive Sublimate	1—1000	.35	6800	$244.41	$1186.38
Creosote Dust	1%	.4	6478	225.49	1030.40
Anthracene Oil Dust	1%	.13	6378	218.86	933.83
Tobacco Dust	99%	.44	6645	243.34	1163.33
Corrosive Sublimate	1%				
Check		35	2148	78.10	356.12

Cost of raising 14520 cabbages and preparing for market $391.80.

Trials of New Materials

Each year we endeavor to test a certain number of new materials and owing to the excellent results obtained from creosote oil used as a dust as a control for cabbage maggot, it was decided to endeavor to test the different main types of products that enter into the composition of this material, since, to secure the different ingredients as pure chemicals was not possible. The creosote oil used in these experiments is said to consist of the following:—

1. Liquid neutral hydrocarbon oils.
2. Pitch and high boiling hydrocarbons, such as phenanthrene.
3. Naphthalene.
4. Tar acids or cresylic acid.
5. Pyridine bases.

The Barrett Company furnished us with samples of these ingredients and some others. In addition we obtained a liquid which, for convenience, we have called "gas tar," which is a waste product from the gas works at Halifax. This material is ordinarily designated "ammonia

liquor" and is utilized in the manufacture of ammonium sulphate. It contains 14–15% of ammonia. Otherwise its exact composition is unknown.

These were tested in small experiments in which the plots were arranged in triplicate as follows:

PLOT 1. CRESYLIC ACID. This material contained approximately 80% total cresols, as well as a small proportion of phenol and some of the higher boiling tar acids.

PLOT 2. CRUDE NAPHTHALENE. This was a crude material containing around 85–90% of actual naphthalene, the remainder being oils that mainly accompany naphthalene.

PLOT 3. PYRIDINE BASES, the crude commercial product.

PLOT 4. CRUDE CRESYLIC ACID, 95% dark—a crude dark colored acid containing, however, 95% of tar acids. The tar acids may be anything from phenol up to the higher homologues.

PLOT 5. NEUTRAL HYDROCARBON OIL.

PLOT 6. "RESIDUE." Under this name was used a residue rich in pitch and the higher hydrocarbons such as phenanthrene, to the practical exclusion of the other classes of compounds.

PLOT 7. CRUDE XYLENOLS. These came from tar acids boiling mainly above the cresols and regarding the exact composition of which very little is known.

PLOT 8. CRUDE ANTHRACENE. This was 20–25% material, containing all the other materials such as carbazol, phenanthrene and other solid hydrocarbons of the aromatic series.

PLOT 9. ANTHRACENE OIL.

PLOT 10. CHECK. No treatment.

PLOT 11. "GAS TAR."

It is not thought necessary to record the actual figures from these experiments, since, as only 105 plants were used in each, the actual standing of the different treatments would have little significance. It is sufficient to record that with 15% of the check plants destroyed, casualties of a single plant were recorded from 2 treatments only, viz., naphthalene and crude xylenols. It is evident that all the main classes of products entering into the composition of creosote have a marked insecticidal or repellent value.

EFFECT OF TREATMENTS UPON EGGS AND LARVAE

In ascertaining what latitude we may have in applying the different treatments, we must find out whether the material acts merely to repel the flies or whether it acts directly upon the eggs or upon the larvae and to what extent they are most effective against maggots of different ages. Accordingly, experiments with this point in view were carried out with corrosive sublimate and creosote dust.

The method employed was as follows:—

Twelve young cabbage plants were set out and covered with screens at the time of planting and around each was placed 50 newly deposited eggs. On the ninth day thereafter two plants were treated in the usual manner with corrosive sublimate (1–1,000) or creosote dust 1%, and two more each day for the following five days, when all had received treatment.

In each case an equal number of checks were left untreated. In this series the exact age of the maggots was, of course, unknown. The incubation period for the eggs of this insect may be from 3–13 days, the average varying from about five to eight days in different seasons. Most of the treated plants, therefore, would be infested with very young larvae.

The work was accordingly duplicated with maggots reared in the laboratory, the definite age of which was, therefore, known. Maggots of from 5 to 11 days old were employed.

The results of this series of tests is shown in the accompanying table. It will be seen that in the case of the first series, no maggots managed to survive in any case with the corrosive sublimate, though a varying number were found on the untreated plants. The fact that better results were obtained than last year is doubtless owing to the better penetration of the material due to a moister soil. The results from the creosote are only slightly less satisfactory.

Effect of Corrosive Sublimate and Creosote on C. M.

Application	No. on treated plant: Corrosive Sublimate	No. on treated plant: Creosote	No. on Check	Remarks
S_1 Maggots Reared in Field				
9 days after deposition	0	0	5	
10 " " "	0	0	12	
11 " " "	0	0	24	Tunnelling noticeable in stems with both materials.
12 " " "	0	1	19	Tunnelling noticeable in stems with both materials
13 " " "	0	1	19	Tunnelling more extensive showing where insects had been at work.
14 " " "	0	2	14	Tunnelling more extensive showing where insects had been at work.
S_2 Maggots Reared in Laboratory				
5 day old maggots	0	0	7	
6 " " "	0	0	4	
7 " " "	0	1	6	
8 " " "	1	1	10	
9 " " "	0	4	8	
10 " " "	2	2	14	

The figure given for the checks is the average of two distinct lots.

In 1921 the soil was so dry that the roots were not so thoroughly moistened by the corrosive sublimate. That the material actually destroyed or drove off the maggots is shown by the plain evidence of tunnelling seen on many plants where no maggots could be detected.

In the second series one, eight day old and two, ten day old maggots survived with the corrosive sublimate, while the creosote dust has again had a marked effect, though not so pronounced as the corrosive sublimate. The small number found on the check is hard to explain. The mortality is here much greater than we would have expected and greater than was actually obtained in other experiments.

These experiments do not settle exactly in what way these two materials affect the maggots. It has been said that the corrosive sublimate does not destroy the eggs, but repels the young maggots after they hatch. In all our experiments, however, we have never known eggs to hatch after having been properly treated with corrosive sublimate; such eggs after a few days invariably shrivelled up. As for the larvae, it is immaterial, from a practical standpoint, whether they are merely driven off, killed outright, or their constitutions undermined to such an extent that they die a lingering death, as long as we can state definitely that maggots up to a certain age are prevented from injuring the plant. We would gather from these figures that it is quite safe to treat with corrosive sublimate up to at least 14 days after the eggs have been laid and with creosote up to 12 days and that maggots up to 8 days old in the case of corrosive sublimate or 7 days old in the case of creosote are destroyed or driven off.

The efficiency of these treatments is dependent largely upon the season. We know, for example, that when the soil is fairly moist the corrosive sublimate penetrates better and is much more effective than when it is dry. Accordingly, it would be interesting to compare the current year's results with those of 1921, which was a very dry year, whereas in 1922 the precipitation was comparatively heavy and the soil was continuously moist.

Unfortunately no figures are available in the case of creosote dust, but the results of similar experiments with corrosive sublimate upon maggots of known age are shown in the accompanying tables. Two lots of maggots were treated, one under both laboratory and field conditions and one under field conditions only.

The following are the results in tabulated form for the first lot.

Laboratory and Field Tests

Age	Conditions	Percentage killed or disappeared.
Eggs	Laboratory	100
	Field	100
	Check	25
1 day	Laboratory	100
	Field	100
	Check	20
2 days	Laboratory	100
	Field	100
3 days	Laboratory	100
	Field	100
7 days	Laboratory	95
	Field	100
	Check	30
9 days	Laboratory	85
	Field	80
14 days	Laboratory	15
	Field	40
17 days	Laboratory	25
	Field	45
Full grown	Laboratory	20
	Field	15
	Check	

Two strengths of $HgCl_2$, viz., 1–1000 and 1–1500, were used on eggs, with 100% killed in each case.

The following are the results from the second lot tested under field conditions only.

Field Tests

Age	Percentage killed or Disappeared
1 day	100
Check	20
2 days	100
Check	40
3 days	100
Check	20
7 days	90
Check	10
9 days	80
Check	15
14 days	10
Check	30
17 days	10
Check	5
Full grown	15
Check	10

It will be noticed that in all cases eggs and larvae up to three days old were destroyed. At seven days from 90 to 100 per cent were killed or disappeared, at nine, from 80 to 85 per cent, at fourteen, a big variation occurs and from this time the results cannot be considered satisfactory or dependable.

No dead maggots were ever found in the field. When the treatment is applied many of the maggots may be observed endeavoring to get away from the area moistened with the liquid. In no case, however, have treated eggs ever failed to be destroyed.

It will be seen from these experiments that considerable latitude in the use of corrosive sublimate is allowable and that even under adverse weather conditions there is no necessity of applying the treatment until several days after the flies appear. We know from other experiments that this material, even though applied before the eggs are laid, remains effective for some time. The same may be said of such treatments as creosote or anthracene oil dust, but not quite to the same extent. Never-the-less, the value of these latter materials in this connection is abundantly proven and experiments looking to their wider use are strongly indicated.

Past President Dean was invited to preside.

Past President Dean: The next paper is "Mercuric Chloride—Its Use for the Control of Root Maggots in Cabbage Seed Beds," by Hugh Glasgow.

CONTROL OF THE ROOT MAGGOT IN CABBAGE SEED-BEDS

(A Comparison of Methods)

By Hugh Glasgow, *Geneva, N. Y.*

Abstract

Control of the cabbage maggot, *Chortophila brassicae* in western New York resolves itself largely into the protection of late cabbage while still growing in the seed bed. Comparisons of the mercuric chloride and cheese cloth methods are decidedly in favor of the former, as regards cost and adaptability, although the method has still to prove its worth during seasons of maximum abundance of the insect. Certain precautions must also be observed since there is danger of burning just as the young plants are pushing through the ground. No other materials tested, except tobacco dust, gave great promise of success.

The cabbage maggot is often thought of primarily as a pest of early cabbage and cauliflower. However, in the cabbage-growing section of western New York, where the production of late cabbage is the rule,

the problem of maggot control resolves itself largely into the protection of the young plants while still growing in the seed-bed.

In this part of the State, where cabbage has developed into one of the major crops and where the seedlings are often produced in immense beds several acres in extent, the protection of the young plants from maggot attack has become a serious problem.

While the pest is not always present in destructive numbers, it is usually common enough to cause an appreciable amount of loss in seed-beds each year. At times it becomes so abundant as to destroy most of the exposed plantings, the result being measured not only by the direct loss to the individual producing the seedlings but by a greatly curtailed acreage set to cabbage during such seasons.

For the protection of seed-beds the chief dependence of cabbage growers during the past ten or fifteen years has been the use of cheesecloth screens applied before or very shortly after the plants appear above the ground. While this method is thoroughly effective and leaves little to be desired so far as control is concerned, it is unfortunately rather expensive and involves a considerable amount of labor. On this account many growers, although recognizing the constant danger of loss from the maggot, continue to produce their seedlings in open beds.

The success which has attended the use of mercuric chloride for the control of the maggot in early cabbage and cauliflower naturally suggested the possibility of adapting this method to the control of the same pest in seed-beds. This, together with the possibility of working out a method of control more flexible and less expensive than screening, led to a series of tests during the past three seasons to determine the practicability of substituting the mercuric chloride treatment for the cheesecloth screen.

In comparing the cost of the two methods, the advantage is decidedly in favor of the mercuric chloride treatment. The total cost of three applications, including labor and bichloride at the rate of one dollar per pound, would be approximately ninety dollars per acre.

To screen an acre of seedlings, distributing the cost of the cheesecloth over five years and that of the lumber over a period of ten years, the total cost per acre would be at least twice that allowed for three applications of the bichloride. This would amount to an added expense of at least ten and twenty cents per thousand plants, respectively, for the two methods.

A further advantage in favor of the bichloride treatment is its adaptability. During some seasons a considerable reduction in the total cost

might be effected; for, if the insect did not appear in sufficient numbers to threaten a serious outbreak after the first treatment, the subsequent applications might be omitted. With screening the total yearly cost is fixed irrespective of the abundance of the pest. On the other hand, the screen, if properly constructed, insures complete freedom from maggot injury as well as affording protection in a large measure from certain other pests, such as the flea beetle, besides stimulating the plants to more rapid growth than where produced in the open.

In the use of mercuric chloride certain precautions must be observed. If the first application is made too soon, just as the young plants are pushing through the ground, there is danger of severe burning. In some cases fifty percent or more of the plants so treated have been lost in this way. This risk, however, is greatly reduced when the first application is deferred until the young plants are well through the ground. If three or four days or even a week is allowed, there appears to be comparatively little danger unless the season is unusually backward and the germination very uneven. After the first application even excessive doses appear to have little effect on the plants, although occasionally a slight stunting is noticed from which, however, the plants quickly recover.

Although a number of materials were tried out on cabbage seed-beds in the course of this work, only one of the tests with mercuric chloride

PLAN AND TREATMENT OF EXPERIMENTAL PLATS

Plat	Row	Seed-bed	Times treated	Date
1	1		1	5–2
	2		2	5–10
	3		3	5–18
1	4		4	5–26
	5		5	6–4
	6		6	6–12
	7		1	5–10
	8		2	5–18
2	9		3	5–26
	10		4	6–4
	11		5	6–12
	12		1	5–18
3	13		2	5–26
	14		3	6–4
	15		4	6–12
	16		1	5–26
4	17		2	6–4
	18		3	6–12
	19		1	6–4
5	20		2	6–12
6	21		1	6–12
			Check	

Fig. 1. Diagram showing arrangement of plats in 1921 cabbage-maggot experiments, with respect to number and frequency of applications for each material to be tested.

will be discussed in detail at this time, since the results are fairly typical of all the experiments. None of the other materials tested, with the exception of tobacco dust, gave any great promise of success.

In order to secure data bearing on the problem from as many angles as possible, such as the proper time to commence treatment, the number of applications necessary to secure satisfactory control and the actual benefit to be derived from deferred applications made to beds already infested by the maggot, the following scheme was carried out for each material in all the detailed tests that were made, namely, for each material or concentration to be tested a block of twenty-one continuous rows was selected, such a block being divided into plats of six, five, four, three, two and one row respectively, as indicated on page 70.

Of the six applications to be put on at weekly intervals, the first was made from four days to one week after the plants had commenced to appear above the ground and included all six rows of Plat 1. The second application included the first and second Plats except that Row 1 was omitted from Plat 1. In the case of the third application Plats 1, 2 and 3 were treated with the exception of Rows 1 and 2 of Plat 1 and Row 1 of Plat 2, which were omitted. This process was repeated at intervals of approximately one week until all six applications were made, one new plat in this way being added and one row successively dropped from each of the preceding plats at each application. At the end of this six-weeks' period we therefore have twenty-one different combinations bearing on the time and frequency with which each of the materials tested may be applied.

The accompanying tables summarize the results of such a test carried on in the same cabbage seed-bed during two successive seasons,—1921 and 1922. In this case the material tested was mercuric chloride diluted at the rate of approximately 1-1200 or 1 ounce to 10 gallons of water. The solution was applied with a watering pot from which the rose sprinkler had been removed so that the liquid could be directed along the rows in a solid stream. The applications were made at the average rate of about 1 gallon to 30 feet, more of the solution being required for the late application than where the plants were young.

During 1921 the infestation, while bad, was not as severe as in some seasons, while in the year following it was much less general, the unprotected plats in 1921 showing an average infestation of 73 percent as against 43 percent for 1922.

As may be seen from the results of these tests summarized in Tables 1 and 2, perfect control was secured in 1922 by two early applications.

A single application, while greatly reducing the amount of injury and giving fair commercial control, failed to prevent injury amounting to nearly ten percent of the total number of plants involved. The second application for 1922 gave results distinctly inferior to that made a week earlier, while the plats treated after this time were not greatly superior to those receiving no treatment at all.

In 1921, on the other hand, where the infestation was much more severe, two early applications were necesary to secure results comparable to those secured with a single one during 1922. Three applications were required in 1921 to insure a perfect stand, while treatments made late in the season were correspondingly less effective than in 1922.

This difference in degree of control shown by the mercuric chloride treatment during two seasons when the pest was unequally abundant, suggests that a certain amount of caution may not be out of place in adapting this method to the treatment of cabbage seed-beds. If three applications were required during 1921 to give the same results secured the following year with but two treatments, might not even three dosages prove inadequate during one of those seasons which may be expected to occur periodically when the insect is present in overwhelming numbers.

In any case, until the method has been given a trial during such a season, it is probably not wise to advise its unqualified substitution for the cheesecloth screen.

Table 1. Control of Root Maggot in Cabbage Seed-Bed During 1921
(Mercuric chloride used at rate of 1 ounce to 10 gallons water)

Plat	Row	Number of applications per row	Date of final application	Number of plants counted	Number infested	Number clean	Percentage clean plants
	1	1	5–2	210	63	147	70.00
	2	2	5–10	196	17	176	91.19
	3	3	5–18	167	0	167	100.00
1	4	4	5–26	190	0	190	100.00
	5	5	6–4	193	0	193	100.00
	6	6	6–12	240	0	240	100.00
	7	1	5–10	239	78	161	66.94
	8	2	5–18	235	25	210	89.36
2	9	3	5–26	203	24	179	88.17
	10	4	6–4	204	17	187	91.66
	11	5	6–12	312	30	282	90.38
	12	1	5–18	191	120	71	37.17
3	13	2	5–26	200	86	114	57.00
	14	3	6–4	166	82	94	56.62
	15	4	6–12	236	145	91	38.59
	16	1	5–26	170	108	62	36.47
4	17	2	6–4	184	92	92	50.00
	18	3	6–12	250	155	95	38.00
5	19	1	6–4	172	132	50	29.07
	20	2	6–12	232	173	59	25.43
6	21	1	6–12	268	206	62	23.31
	Check			1245	902	334	26.82

TABLE 2. CONTROL OF ROOT MAGGOT IN CABBAGE SEED-BED DURING 1922
(Mercuric chloride used at rate of 1 ounce to 10 gallons water)

Plat	Row	Number of applications per row	Date of final application	Number of plants counted	Number infested	Number clean	Percentage clean plants
	1	1	5–12	208	18	190	91.34
	2	2	5–19	218	0	218	100.00
	3	3	5–26	189	0	189	100.00
1	4	4	6–2	198	0	198	100.00
	5	5	6–9	177	0	177	100.00
	6	6	6–16	167	0	168	100.00
	7	1	5–19	178	16	162	91.57
2	8	2	5–26	178	8	170	95.50
	9	3	6–2	133	0	133	100.00
	10	4	6–9	152	0	152	100.00
	11	5	6–16	146	0	146	100.00
	12	1	5–26	153	50	103	67.32
	13	2	6–2	130	45	85	65.38
3	14	3	6–9	156	40	116	74.35
	15	4	6–16	209	70	139	66.55
	16	1	6–2	215	85	130	61.35
4	17	2	6–9	247	90	157	63.56
	18	3	6–16	234	61	173	73.45
	19	1	6–9	210	55	155	73.80
5	20	2	6–16	199	56	143	71.85
6	21	1	6-16	177	65	125	65.78
	Check			1110	482	628	56.16

PAST PRESIDENT DEAN: The next paper is on "The Squash Bug in Massachusetts," by H. N. Worthley.

THE SQUASH BUG IN MASSACHUSETTS

By H. N. WORTHLEY, *Amherst, Mass.*

ABSTRACT

The life-cycle of the squash bug, *Anasa tristis*, in Massachusetts has been worked out and compared with the records for other parts of the country. An attempt to find an efficient insecticide for the destruction of adult bugs without injuring the vines was unsuccessful. Brief notes on a Tachinid parasite, *Trichopoda pennipes* are given.

The squash bug (*Anasa tristis* De Geer) is an ever present pest of cucurbits in Massachusetts. It is locally abundant every year, but causes serious loss only occasionally. The worst damage in Massachusetts appears to occur when overwintered adult bugs are abundant in the spring, sucking the juices of the seedling plants, which are killed outright. Weed and Conradi (5)[1], p. 15, give an account of a serious outbreak in New Hampshire, in which "as soon as squashes, cucumbers, and other plants of the vine family were out of the ground in spring, the

[1]Numbers in parenthesis refer to "Literature cited."

bugs began to destroy them, coming in such extraordinary numbers as to occasion very general comment." It may be that during a dry, hot August the nymphs also would cause serious loss, but within the writer's experience plants which have escaped destruction by the adults are well able to support the nymphs, due to the tremendous mid-summer growth of cucurbits.

Seasonal History

The time during which the various stages in the life of the squash bug are present in Massachusetts is shown in the accompanying chart (fig. 2), which is a record of field observations during the seasons of 1920, 1921, and 1922. In addition, the chart is of interest in its record of the year 1921. A glance at the chart will show that all stages were present in the fields for a shorter time than in the other two years, and that all bugs had left the fields at least a month before the first killing frost. This early completion of its seasonal activities seems best explained by the late fall of 1920 and the mild winter and early spring of 1921. These combined to cause a rapid emergence of the overwintered adults, and a subsequent concentration of oviposition in the latter part of June and early July. Since all nymphs had reached the fifth instar by September first, their development was not retarded by the cool September weather, as in average years. The fact that all adults had left the fields nearly a month before the vines were killed by frost seems to indicate that they normally do only a certain amount of feeding before seeking winter quarters.

In 1921, as soon as the peculiarities of the season were evident, a close watch was kept on bugs in the field and on those in breeding cages as well, but no mating or egg laying by the newly developed bugs was observed. It seems safe to say, therefore, that there is never more than one generation of the squash bug each year in Massachusetts, for if it were possible for a partial second generation to develop, it would surely appear in such a season as that of 1921.

Table 1. Length of Developmental Stages of Squash Bug, Amherst, Mass.

Stage	Number of Individuals	Time days	Average days
Egg	151	11–16	13.7
1st instar	86	3– 4	3.3
2d instar	85	3–11	6.6
3d instar	82	4–13	6.6
4th instar	63	4– 9	6.4
5th instar	59	9–22	16.6

Total from egg to adult 34–75 days, average 53.2 days.

Table 1 is a summary of breeding records obtained in life history cages. The variations exhibited are due in part to temperature differences, but

FIG. 2. Seasonal History of *Anasa tristis* De G. at Amherst, Massachusetts

are also in part individual, since specimens hatching the same day from the same egg cluster and kept in the same cage have been known to become adult as much as fourteen days apart.

A tabulation (Table 2) of the lengths of the various developmental stages shown by the cage records of three seasons at Amherst, compared with the findings of Chittenden (1), p. 24, Weed & Conradi (5), p. 17-18, and Wadley (4), p. 419, is of interest as showing regional variations in the lengths of the different developmental stages.

TABLE 2. DEVELOPMENTAL STAGES OF SQUASH BUG IN DIFFERENT LOCALITIES

Stage	Washington, D. C.	New Hampshire	Kansas	Massachusetts
Egg	9–10 days	11 days	7–17 days	13.7 days
1st instar	3	3	2.1—5.2	3.3
2d instar	8–9	9	6.2—9.2	6.6
3d instar	7–8	8	8.1–13	6.6
4th instar	6	7	10	6.4
5th instar	8	9	12	16.6
Total	41–44 days	47 days	45.4–66.4 days	53.2 days

CONTROL MEASURES

Since the chief injury by squash bugs in Massachusetts seems to be that caused by the overwintered adult bugs and because the vines largely cover the ground by midsummer when spraying for the nymphs must be carried on, an effort has been made to find a material which will kill adult bugs without injuring the vines. The investigation has so far proved fruitless, but it may be of value to report the materials tried, and the results obtained. In each test several bugs were treated, placed on a fresh leaf under a lamp chimney covered with cheese cloth, and kept under observation for three days.

Standard Insecticide (Lemon Oil Co., Baltimore, Md.) 1–16, (3) p. 166.
Against adults—no effect.

Sodium sulfide (3), p. 165.
Against adults—no effect.

Sulco-V. B. (Cook & Swan Co., New York City) 1920[1] sample, 1–25.
This material which is a miscible oil, was partially effective against 4th instar nymphs. Adults, however, were unaffected, and the foliage was killed.

Emulsion of CS_2 and liquid soap, equal parts.
Apparently killed all instars and adults very rapidly but all revived within a few hours of the application.

Linseed Oil Emulsion, 1–9, (3), p. 168.
Against adults—no effect.

Linseed Oil Emulsion, 1–9, plus Black-leaf "40", 1–500.
Against adults—no effect.

[1]The year is given because the material called Sulco-V. B. differed markedly in its composition in 1920, 1921 and 1922.

Black-leaf "40," 1–500.
Not effective against nymphs older than 2d instar.
Black-leaf "40," 1–100, plus soap, 1 oz. per gallon.
Not effective beyond 3d instar.
Nicotine sulfate dust (homemade) about 2%.
Not effective beyond 3d instar.
Nicotine sulfate dust (Cal. Walnut Growers' Ass'n. 1921).
Not effective beyond 4th instar.
Nicotine sulfate dust (Dosch 1922) 4%, killed 15% of adults.
Nicotine sulfate dust (Dosch 1922) 2%, killed 15% of adults.
Fish-oil soap (Sterlingworth) 1 lb. in 3 gals. water.
About 80% effective against 3d instar nymphs.
Fish-oil soap, 1 lb. in 3 gals. water plus 3 oz. sulfur.
Partially effective against 4th instar nymphs, ineffective against adults.
Fish-oil soap, 8 oz.; water, 1 gal.; sulfur, 2 oz.; ineffective against adults, and caused severe burning.

The last-named mixture was reported by F. M. Wadley (4), p. 423, as a satisfactory means of killing adult squash bugs in Kansas. It was hailed with delight by the writer, and given repeated tests. 90% of adult bugs *dipped* in the mixture while it was warm were killed, but only a small percentage of those sprayed with the mixture while warm, and of those dipped or sprayed with the cold mixture, succumbed. In addition, this material caused severe foliage burn.

It will be noted that nicotine sulfate dust killed a few adults in the experiments. Three or four direct puffs were given the bugs, which resulted in a more liberal application than they would ordinarily get in field work. Still, the dust has killed adult bugs, and since there is reason to believe that the dusts will be improved, we may look forward with hope to the production of a material which can be used with safety and success even against an insect which has proved to be as resistant as the common squash bug.

The Tachinid Parasite, *Trichopoda pennipes* Fabr.

A more extensive paper on the biology of this species is being prepared by the writer, but a few statements may properly be given here. This beneficial fly has two generations yearly in Massachusetts. As many as 80% of overwintered squash bugs have been observed to bear eggs of the parasite. Many of these bugs, however, live to deposit a part, at least, of their eggs.

The accompanying chart (fig. 3) explains the relation existing between parasite and host as it appeared in 1922 at Amherst. For economy in space, the egg stages, which are not significant in this connection, have been omitted. Flies of the second generation lay their eggs upon the

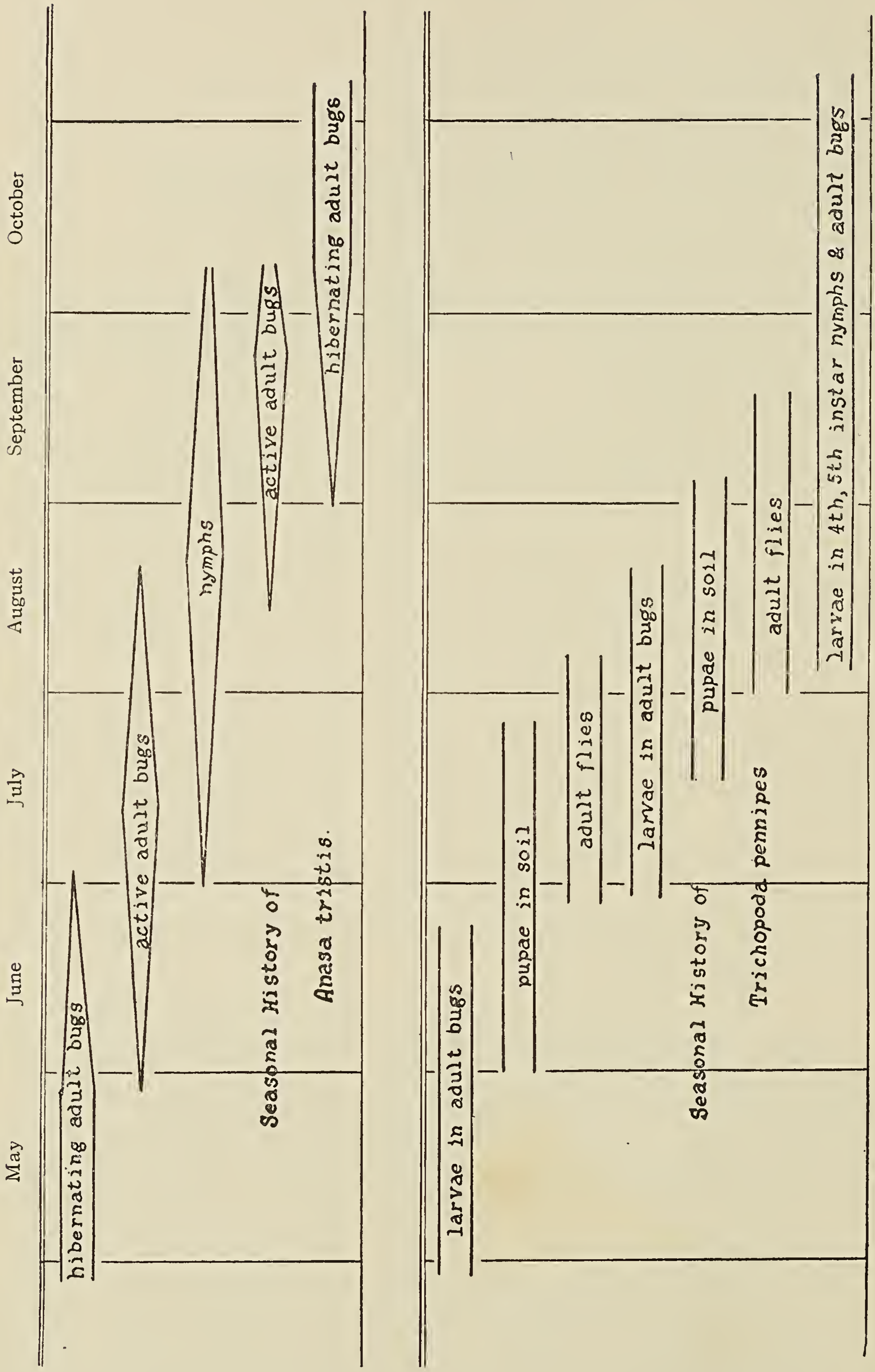


Fig. 3. Relation of *Trichopoda pennipes* to its Host, *Anasa tristis*, Amherst, Massachusetts, 1922

older nymphs and adult bugs, and the larvae of this generation pass the winter within the body of the host. None of the bugs parasitized by the second generation flies appear to live long enough to oviposit the following spring. Thus, although the efficiency of the parasite has been questioned, due to the fact that parasitized female bugs have been observed laying eggs, (1) p. 26; (2); (5) p. 21, it would seem that the parasite is capable of causing a considerable reduction in numbers of the host in Massachusetts.

Literature Cited

(1) Chittenden, F. H. "Some Insects Injurious to Garden and Orchard Crops," U. S. D. A., Div. Ent. Bull. 19, N. S., 1899, pp. 20–28.

(2) Packard, A. S. "A Tachina Parasite of the Squash Bug," American Naturalist, Vol. IX, p. 519, 1875.

(3) Vinal, Stuart C. "The Greenhouse Red Spider Attacking Cucumbers and Methods for Its Control." Mass. Agr. Exp. Sta. Bull. 179, 1917.

(4) Wadley, F. M. "The Squash Bug," Journ. Econ. Ent., Vol. 13, No. 5, pp. 416–425, 1920.

(5) Weed, C. M. & Conradi, A. F. "The Squash Bug," New Hampshire Agr. Exp. Sta. Bull. 89, 1902.

Past President Dean: We will now listen to a paper on "The Onion Capsid," by P. A. Glenn.

THE ONION CAPSID, *ORTHOTYLUS TRANSLUCENS* TUCKER

By P. A. Glenn, *Chief Inspector, Division of Plant Industry, Department of Agriculture, Urbana, Ill.*

Abstract

The onion Capsid, *Orthotylus translucens*, occurs in Illinois on wild garlic and attacks onions. The life-cycle is briefly summarized and spraying with whale oil soap recommended, Burning over garlic fields and fall plowing are excellent preventives.

This insect pest was seen by the writer at Olney, Illinois, May 15, 1915, on cultivated onion, and was identified for me by C. S. Spooner. The species was described by Elbert S. Tucker from a single male specimen collected in 1894 in Cheyenne Canyon near Colorado Springs. The description was published in Volume IV (old series) XIV (new series) No 2, University of Kansas *Science Bulletin*, 1907. The type is now in the collection of the University of Kansas. Mr. Tucker makes the

following statement in regard to it: "Otto Heidemann considers the specimen 'near *prasinus* Fallen'. The description of *O. viridicatus* Uhl. agrees very closely, the most notable distinction being the black membranes of that species."

May 15, 1915 is the earliest record of its presence in Illinois. The writer has not been able to find any reference to it in economic literature. Its destructive character as revealed by observations made in the vicinity of Olney in 1915, '16, and '17 warrants us in recording it as one of our injurious insects.

Its chief food plant at Olney was wild garlic, commonly but erroneously called "wild onion" by the people of that locality. No doubt it will accept wild onion as a host plant as readily as wild garlic but this has not been verified. It might therefore, more properly be named the "garlic capsid" but since its economic importance depends upon its relation to the cultivated onion I have chosen to suggest that it be named the "onion capsid."

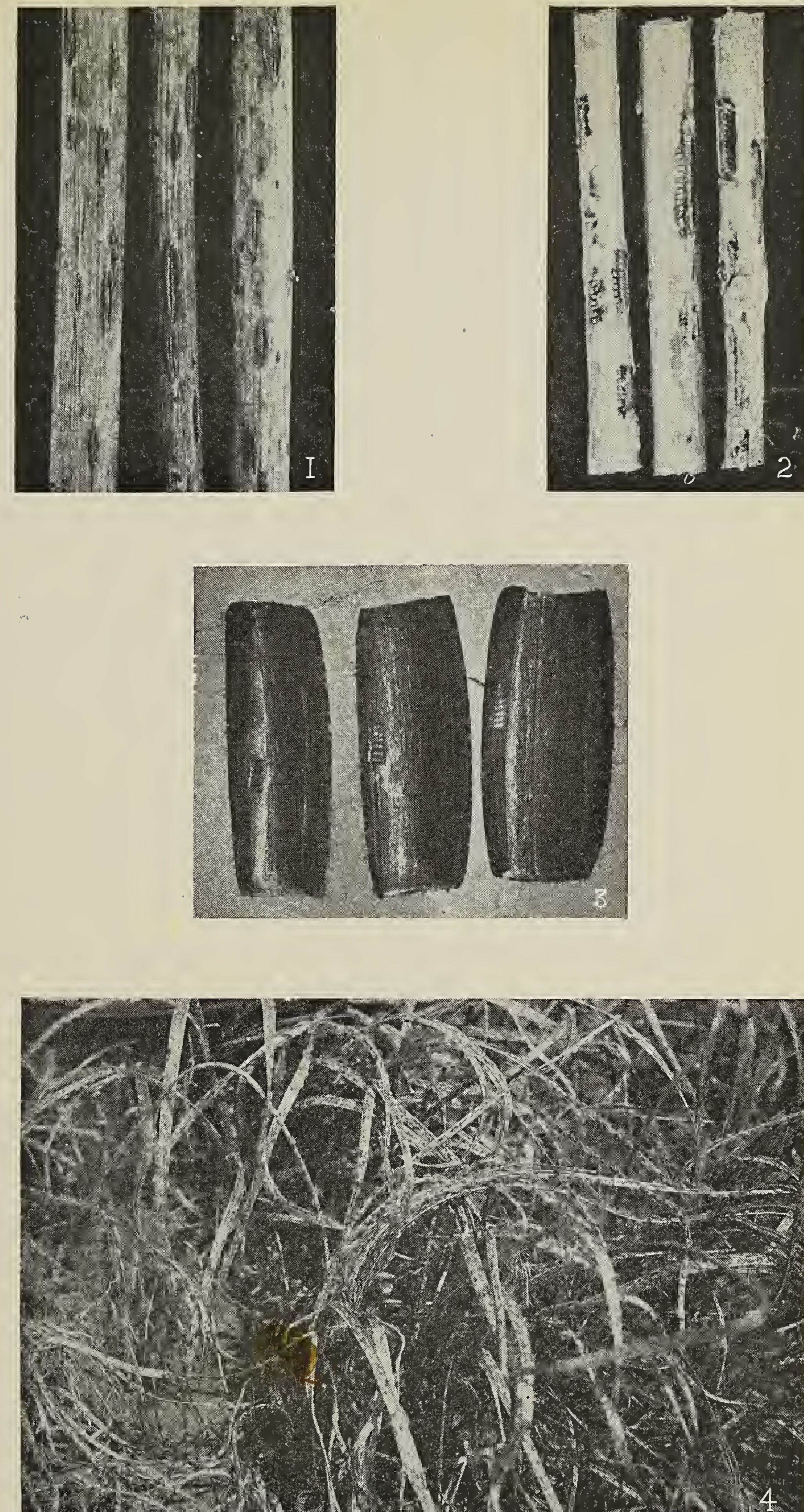
The tops of the onions on which the insects were first seen were at the time killed half way to the ground and later most of the tops were killed to the ground. The same condition prevailed in a number of patches visited. The insects found were all adults. The owners reported that they had appeared very suddenly a few days before my visit, and that this had been a frequent occurrence in former years in that locality. One man reported later that they were also abundant on the "wild onion" growing in his pasture. This gave a clew to the situation and by observations made during the two following years it was learned that wild garlic, which is abundant in that locality, is the natural host plant of the species.

The eggs are deposited in longitudinal slits made in the fruiting stalks of the plant, as shown in Pl. 1, Figs. 1, 2, and 3, from five to twenty eggs being deposited in each slit. The insect hibernates in the egg stage, hatching continues throughout April, adults begin to appear about the first week in May and are to be found until about June 10, and oviposition begins about May 15th and continues until the adults disappear. A few eggs were found in tops of cultivated winter onions, but cultivated onions do not appear to be nearly as attractive to the female for purposes of oviposition as garlic.

The young nymphs are green with orange colored thorax and red eyes, the later stages and the adults are uniform light yellowish green.

The adults are very active flyers and when abundant swarm from wild garlic fields to the cultivated onion and soon suck the life out of

Plate 1



1. Fruit stock of wild garlic with egg punctures of onion capsid.
2. Radial section of fruiting stock of wild garlic to show eggs of onion capsid in position.
3. Radial section of cultivated onion showing eggs of onion capsid.
4. Wild garlic plants showing onion capsid.

the tops, causing them to turn yellowish white, wilt and die, thus stunting the growth of the onion.

During 1915, 1916 and 1917 they were extremely abundant in the vicinity of Olney. When one approaches infested plants the capsids scurry to the ground and seek shelter under rubbish or in cracks in the ground, and so abundant were they when these observations were made that they almost covered the ground in the garlic fields as one walked through them. Figure 4 will give some idea as to their abundance on the plants.

They were seen at various other points in the southern half of the State, but serious injury was noticed only at Olney. Wherever garlic fields are present the insect may well become a limiting factor in the protection of onions.

Whale oil soap used at the rate of one ounce to a gallon of water killed both adults and nymphs almost instantly. And where garlic fields had been burned over or plowed under in the fall, practically no capsids were present the following year.

President Sanders resumed the Chair.

President J. G. Sanders: The next on our program is "Pepper Maggot, a New Pest of Peppers and Egg Plants," by Alvah Peterson.

PEPPER MAGGOT, A NEW PEST OF PEPPERS AND EGG PLANTS

By Alvah Peterson, *New Brunswick, N. J.*

(Withdrawn for publication elsewhere)

President J. G. Sanders: We will now listen to a paper on "Dusting for the Pea Aphis," by E. N Cory.

DUSTING FOR THE PEA APHIS

By Ernest N. Cory, *State Entomologist, College Park, Md.*

Abstract

Dusting is most promising for pea aphis control. The principal tests were to determine the most effective percentage of nicotine. A high nicotine content and not less than 30 lbs. of dust per acre are preferable. The use of a trailer of canvas is advised. There should be at least 50 percent of the vines infested when dusting is begun.

Dusting seems to hold the greatest promise in the economical control

of the pea aphis, owing to the various difficulties that are always present in spraying. This is particularly true in the spraying of broadcast canning peas.

Counts of the yields on infested and uninfested market peas grown in the fall of 1922 at Cambridge, Maryland, showed beyond doubt that the pea aphis does considerable injury.

Table I. Effect of Aphis on Yield.
Farm of W. A. Byrn, Cambridge, Md.
October 19th, 1922

Yield from 100 feet of heavily infested vines	
Number of pods with two or more peas	892 or 63%
Number of flat pods, unmarketable	517 or 37%
Estimated yield on basis of quantity picked	50 bushels
Yield from 100 feet of uninfested vines	
Number of pods with two or more peas	1891 or 79%
Number of flat pods, unmarketable	512 or 21%
Estimated yield on basis of quantity picked	145 bushels

A comparison of dusted and undusted fields shows that the yields on the former are higher and that the number of marketable peas is increased by control of the aphis.

Table II. Effect of Dusting on Yield
Hirst Farm, Cambridge, Maryland
October 12, 1922

Counts from 100 yards of undusted vines	
Number of pods with three or more peas per pod	374 or 37%
Number of pods with one or two peas per pod	192 or 19%
Number of pods with no peas	436 or 44%
Counts from 100 yards of dusted vines, 35 lbs. per acre 5% dust.	
Number of pods with three or more peas per pod	1028 or 44%
Number of pods with one or two peas per pod	682 or 29%
Number of pods with no peas	634 or 27%
Increase in marketable peas	17%

The kind of dust material that gives the best results was tested on fall grown market peas. The tests show that nicotine alone, of all the materials tested, can be relied upon to give satisfactory results. The following table shows in brief the results with various combinations:

Table III. Tests of Insecticides
Jackson Farm, Cambridge, Md.

Exp No.	Date	Kind of Dust	Quantity in lbs. per acre	Per cent kill	Remarks
1.	9/27/22	Dosch 2.4% Nicotine	45–55	75–80	Light, volatile dust
2.	"	Nicotine 3%, kerosene 5%, lime	45	75–80	
3.	"	Nicotine 3%, lime	55	80	
4.	"	Kilspray 5%. lime	75	10	Pyrethrum extract
5.	"	Derrisine 5%, lime	50	10	
6.	"	Nico-Tone, 1½ % nicotine	35	15	Very heavy
7.	"	Ace-Hy	25	10	
8.	"	Check			No unusual mortality
9.	"	Niagara 3%, nicotine	50	90	
10.	"	Niagara 5%, nicotine	45	95+	

Temperature 75°. Dry. Very little breeze. Noon to 4:30. 85% of plants infested at time of dusting.

The principal tests were on the percentage of nicotine most effective, the quantity that should be used and the method of application.

Table IV shows in condensed form the results. While the dust from several manufacturers was used, no attempt is made to show a comparison as the conditions were different in each case.

The percentage of kill is based on counts of infested plants prior to dusting, and similar counts twelve hours after dusting.

TABLE IV. TESTS OF NICOTINE DUST
Byrn Farn, Cambridge, Md.

Field A.	Exp	Date	Kind of dust	Quantity in lbs. per acre	Per cent kill	Remarks
4 acres	1	9/22/22	Niagara, 2%	15	44	No canvas.
	2	"	Niagara, 2%	30	71	No canvas.
	3	"	Niagara, 3%	30	68	10 ft. canvas.
	4	"	Niagara, 5%	30	78	10 ft. canvas.
	5	10/7/22	Niagara, 3%	25	75–80	3 lbs. Arsenate of lead to kill loopers.
Slight breeze. Temperature 70°–66. Noon to 4:30. 2 rows allowed for drift.						
Field B. 2 acres	1	9/23/22	Niagara, 5%	25	63	10 ft. canvas.
	2	"	Niagara, 3%	43	71.4	10 ft. canvas.
Temperature 78°. No breeze. Noon.						
Field C. 1½ acres	1	9/23/22	Niagara, 5%	50	85–100	18 ft. canvas.
	2	"	Niagara, 5%	25	85–100	18 ft. canvas.

Temperature 78°. No breeze. Noon. Higher per cent kill on middle rows. 4 rows between plots. Average infestation 16.7%.

Austin Farm, Cambridge, Md.

Exp No.	Date	Kind of Dust	Quantity in lbs. per acre	Per cent kill	Remarks
1.	9/26/22	Dosch, 2.4%	110	85–95	With the wind.
2.	"	" "	60	65	Against the wind.
3.	"	" "	30	50	Dusted with and against the wind.
4.	"	" "	30	50	With the wind.
5.	"	Check			

Temperature 75°–80°. High wind. Noon. Per cent plants infested September 21, 1922—41.5

The tests herein recorded were supported by demonstration dusting on a commercial scale at eight farms. The results on these farms, together with the above data, indicates to us that less than thirty pounds per acre of nicotine dust is not practicable and that a high nicotine content is preferable to the low content.

The use of a trailer of canvas is highly desirable in order to get the maximum fumigation, and the dusting should be done in as calm weather as possible. Good results seem to be possible at temperatures around 70° F.

Our experience indicates that to obtain the best results for the money expended in dusting, there should be at least 50% of the vines infested when dusting is begun.

PRESIDENT J. G. SANDERS: The next paper is entitled "The Possibility of Transmitting a Weevil infestation from wheat to macaroni through the process of milling and manufacturing," by Royal N. Chapman.

THE POSSIBILITY OF TRANSMITTING A WEEVIL (*SITOPHILUS*) INFESTATION FROM WHEAT TO MACARONI THROUGH THE PROCESS OF MILLING AND MANUFACTURING

By ROYAL N. CHAPMAN, *St. Paul, Minn.*

(Withdrawn for publication elsewhere)

PRESIDENT J. G. SANDERS: We will now hear a paper entitled "Vacuum Fumigation Experiments Using European Corn Borer and Browntail Moth Larvae Under Winter Conditions," by R. I. Smith.

VACUUM FUMIGATION EXPERIMENTS WITH BROWN TAIL MOTH AND EUROPEAN CORN BORER LARVAE UNDER WINTER CONDITIONS

By R. I. SMITH, *Boston, Mass.*

(Withdrawn for publication elsewhere)

PRESIDENT J. G. SANDERS: The next paper is "Further Data on Fumigation with Hydrocyanic-acid Gas in Greenhouses on a Commercial Basis," by E. R. Sasscer and C. A. Weigel.

FURTHER DATA ON FUMIGATION WITH HYDROCYANIC ACID GAS IN GREENHOUSES ON A COMMERCIAL BASIS

By E. R. SASSCER AND C. A. WEIGEL

ABSTRACT

The formula used was 1 ounce avd. sodium cyanide, 1–½ liquid ounces sulphuric acid (1.83 specific gravity) and 3 fluid ounces of water. Frequent one hour exposures in a greenhouse containing a large number of different plants, were followed by no permanent injury, though temporary burning occurred on such plants as jasminum,

salvia, etc., and the insects were practically eliminated except mealy bugs and these greatly reduced by the killing of immature larvae. Results are also given for the fern scale, the camphor scale and the Florida red scale.

In a preliminary report[1] some data on the subject of fumigating greenhouses with hydrocyanic-acid gas on a commercial basis was presented. The purpose of this paper is to give additional data on the same subject based on experiments conducted during the current year. The following formula was used in all of the tests: For each ounce avoirdupois of sodium cyanid (containing approximately 51% cyanogen), 1½ liquid ounces of sulphuric acid (1.83 specific gravity) and 3 fluid ounces of water were used. This is a slight divergence from the 1–1½–2 formula which has been generally accepted owing to the necessity of securing sufficient dilute acid to submerge the cyanid. Under greenhouse conditions, it is necessary to use a number of generators in order to secure an equal distribution of gas, and as this number is increased, the amount of chemicals in each generator is proportionately decreased, which will result in poor generation unless there is a slight excess of water. If it were possible to have a number of small generators considerably constricted at the bottom it would be possible to get a satisfactory generation with the 1–1½–2 formula.

Experiment I

It appeared advisable to determine whether a greenhouse could be kept free from infestation of the common insects, as white flies, aphids, mealybugs, greenhouse Orthezia, etc., by subjecting the plants thereof to frequent one hour exposures of the gas at weak concentrations. An opportunity to conduct such an experiment presented itself during the early part of this year in a fairly tight propagating house of the United States Botanic Gardens, containing approximately 43,000 cubic feet of air space. The plants growing in this house represented 68 genera or about 120 varieties of the more common herbaceous and flowering plants, most of which were in 3″ pots or rooted directly in the propagating benches. The plants were obtained mostly from cuttings taken late in the season from plants grown out-doors during the summer, and in most cases were quite heavily infested with common mealybugs, greenhouse Orthezia, ants, and other hot house insects, when the experiment was undertaken. The first and second exposures were at the rate of ¾ ounce and ⅔ ounce of sodium cyanid per 1,000 cubic feet of space respectively, while in each of the last five exposures ½ ounce per 1,000

[1]E. R. Sasscer and C. A. Weigel, Jour. Econ. Ent. June 1922, Vol. 15, No. 3, pp. 200–204.

cubic feet was used. The first exposure took place January 6, and the others on the following dates: January 20, February 9, March 1, 17, 31, and April 21. The ventilators were so arranged that they could be operated from the outside and upon completion of the exposures they were opened for 15 to 20 minutes to permit the escape of gas. As is indicated in Table 1, which gives detailed information on the dosage and atmospheric conditions, the average temperatures in the greenhouse ranged between 58.2° F. to 65° F. for the wet bulb, and from 60.2° F. to 70° F. for the dry bulb, with an average humidity of 82%, while the outside temperatures were from 25° F. to 40° F.

Table 1.—Dosage and Atmospheric Conditions on the Dates of Fumigation

Date 1922	Amount of sodium cyanid per 1,000 cu. ft. of space.	Temperature in degrees Fahrenheit			Relative Humidity Pct.
		Inside house		Outside house	
		Wet bulb	Dry bulb		
Jan. 6	¾ ounce	63.2	69.5	36	71
" 20	⅔ "	63.3	68.6	40	75
Feb. 9	½ "	—	70.0	34	—
Mar. 1	" "	—	64.0	25	—
" 17	" "	64.0	68.0	42	78
" 31	" "	62.4	63.6	44	95
Apr. 21	" "	58.2	60.2	41	89
	Averages	62.2	66.2	37.4	81.6

Results: While slight but only temporary burning occurred on such plants as jasminum, parlor ivy, marguerite daisy, ageratum, salvia, geranium, dahlia, cestrum, heliotrope, and stephanandro, no permanent injury followed. The insects referred to above were practically eliminated with the exception of the mealybugs, and these were greatly reduced in numbers by the repeated fumigations which killed off the immature larvae. These results are significant since they indicate that many of the common greenhouse pests may be controlled in houses containing a miscellaneous collection of plants, by fumigating them at intervals, using a low concentration of gas, without any serious or permanent injury to the plants.

Experiment II. Control of the Fern scale, *Hemichionaspis aspidistrae* (Sign.), and the Hemispherical scale, *Saissetia hemisphaerica* (Targ.)

The results of another experiment indicate that with one exposure to the gas a house containing *Nephrolepis bostoniensis* in commercial numbers may be successfully fumigated using 1 ounce of sodium cyanid per 1,000 cubic feet of space with an exposure lasting 1 hour.

The air space of this house was 35,000 cubic feet and the fumigation took place between 7 and 8 o'clock at night. The temperature readings

were 68° F. for the dry bulb and 66° F. for the wet bulb, with a humidity of 89%.

In this instance 99% mortality of the fern scale was secured as compared with 80% of the hemispherical scale. In addition to *Nephrolepis bostoniensis*, two other varieties of ferns, viz: *N. scottii* and N. Teddy Jr., were represented. The latter suffered severe burning as did the following florist's greens, *Asparagus plumosus* and *A. sprengeri*, which were also in the greenhouse fumigated.

Experiment III. Control of the camphor scale, *Pseudaonidia duplex* (Ckll.)

The fumigation tests conducted at New Orleans during August and September 1921, and again in January and February 1922, indicated that 1 ounce sodium cyanid per 1,000 cubic feet of space was effective against this coccid when the temperatures ranged from 45° F. to 70° F., whereas ¾ ounce per 1,000 cubic feet sufficed at temperatures above 70° F. These results are based on the examination of 20,470 specimens.

Miscellaneous Fumigation Results

At intermittent periods during the year numerous box and greenhouse fumigation tests were carried on, and further data were accumulated on the control of the insects and host plants listed below.

The Florida red scale, *Chrysomphalus aonidum* (Linn.), on palms, ficus, citrus, and camphor, was controlled by fumigation at the rate of 1 ounce sodium cyanid per 1,000 cubic feet of space, at a temperature of 78° F. and 87% humidity, with no injury to the plants. Similarly with *Saissetia nigra* (Nietn.), on adiantum ferns, roses, moon-vine, peristrophe, citrus and camphor, a mortality of 83% resulted from two exposures to the gas at same rate, at a temperature of 67° F.; also *Chrysomphalus dictyospermi* (Morg.); *Pseudococcus nipae* (Mask.); *Cerataphis lataniae* (Bois.), on Kentia and Areca palms; and *Parlatoria theae viridis* Ckll. on Aucuba japonica, a 98% control was obtained, with no injury to the host plants. The fumigated plants showed a decided stimulation of growth.

President J. G. Sanders: This is a line of work that promises great development and is an interesting and profitable one. I believe our greenhouse men probably have received less thought and attention from the entomologists and plant pathologists than any other line of agriculturists.

We will pass to the next paper on the program "Results of Spraying and Dusting for the control of the red spider," by D. M. DeLong.

RESULTS OF SPRAYING AND DUSTING FOR THE CONTROL OF THE RED SPIDER (*PARATETRANYCHUS PILOSUS*)

By D. M. DeLong, *Ass't Prof. of Entolomogy, Ohio State University*

Abstract

Red spider, *Paratetranychus pilosus*, has been a serious pest on several types of fruit trees in the Erie-Chautauqua fruit section. The mites appear on the foliage early in the spring and develop from egg to adult in two to three weeks, there being such an overlapping that eggs and adults were always present; consequently effective dusts must remain active upon the foliage for some time. A lime sulphur wash, 1 to 40 easily controls red spider, though it is too strong for prune foliage, which at times may be seriously injured by 1 to 75. The control by various sulphur dusts in combination with arsenate of lead or nicotine did not vary greatly, ranging from 50 to 60 percent. Soap added to a lime sulphur wash, increases its value by at least 5 to 10 percent. A 1 percent lime sulphur with 6 lbs. of sulphur paste for each 100 gals. and 1 lb. of resin fish oil soap gave very satisfactory control.

For several years the red spider (*Paratetranychus pilosus*) has been a very serious pest on the foliage of several types of fruit trees in the Erie Chautauqua fruit section. Injury has been especially serious on the foliage of York State prunes, in many cases being so conspicuous that the yellowing of the foliage could be noticed at some distance from the orchard. As a consequence severe losses were suffered due to the delayed ripening, sour flavor and smaller size of fruit at the time of picking. Also where the trees were heavily loaded premature dropping of fruit was noticed after the foliage was seriously injured. The red spiders appeared on the foliage very soon after the leaves were out in the spring, having over-wintered in the egg stage on the bark, and were present in increasingly large numbers on both surfaces of the leaf throughout the season. No accurate data were obtained concerning the number of generations during the summer, but individuals were able to pass from the egg to the adult stage in from two to three weeks and the generations overlapped to such an extent that eggs and adults were always present. Thus the problem of control is in obtaining some material which will remain active upon the foliage for some time so that a second application after the eggs hatch will not be necessary. Several combinations of dust and spray have been used in an attempt to obtain the best control. Sulphur dust has been recommended by several stations as the best method of control. At least five different combinations of sulphur dust were used. 1. Sulphur dust alone; 2. Sulphur Arsenate of lead dust 90–10; 3. Sulphur, arsenate of lead-lime dust 75–10–15; 4. Sulphur dust with 1% nicotine; and 5. Sulphur dust with 3% nicotine sulphate. The dust was applied from both sides of the row, there was

no wind during the application and a very uniform and thorough covering of the foliage was secured. The trees were about 12 years old and approximately 2 lbs. per tree was used.

There was very little difference in the amount of control secured on the different dust plots, the number ranging from 50% to 60%. The nicotine dust gave no better results than the sulphur dust alone, although applied while the foliage was wet with dew. The addition of lime and arsenate of lead seemed to make no difference in the percentage of killing. For several days following the application the sun was bright and the temperature was high which should have produced ideal conditions for the liberation of sulphur dioxide and consequent killing. Thus the dust acted only as a check and could not be considered an economic control.

In order to get a comparative test, sprays were also used. The lime sulphur alone used at the rate of 1 to 65 and 1 to 75 gave a good control but was rendered more effective by the addition of resin fish oil or even laundry soap at the rate of one pound to 50 gallons. The soap although incompatable seemed to increase the toxicity at least 5 or 10%.

The California recommendation of T. D. Urbahns is a much better spray and gave a very satisfactory control. This mixture is composed of a one percent lime sulphur solution to which has been added six pounds of sulphur paste for each 100 gallons. In California a paste spreader has been used, but a pound of resin fish oil soap added greatly to the efficiency when used with this mixture in place of the paste spreader.

It might be quite possible and easy to control the red spider with lime sulphur alone if it could be used at a 1 to 40 strength but this is too strong for prune foliage. The tender foliage and caustic properties of lime sulphur must be seriously considered in choosing this spray formula. At certain times a solution as strong as one gallon of lime sulphur to fifty of water can be used without injury to the foliage. At other times a mixture of one gallon to seventy-five of water will cause conspicuous burning. The condition favorable for burning in this case seems to be the abundance of humidity in the air and the consequent slow drying of the spray as it hangs on the edges and tips of the leaves. If the spray dries quickly, no burning results. If it hangs on the leaf for some time in a liquid condition it will burn in almost every case. This was well illustrated by a row of trees sprayed in the evening just before sundown. The portions of the trees exposed to the sun dried and were not injured while the shaded portions upon which the spray did not dry, although applied first from the same tank, were burned

severely. It therefore is necessary to be very careful to use a weaker solution upon prune foliage when attempting to control red spider.

Mr. J. S. Houser: We have been doing some work with this pest in northern Ohio near Youngstown where it has been prevalent for at least three years. This orchard has been carefully sprayed each season, using the dormant application of lime sulphur and the full complement of summer sprays in which lime sulphur liquid 1–40 was the fungicidal agent employed. The dormant strength lime sulphur had failed to destroy the overwintering eggs and the summer applications had failed to destroy the hatched mites. However, miscible oil applied in the spring was found to be very efficient in destroying the over-wintering eggs and the treatment was observed to have a lasting effect throughout the season.

Mr. E. N. Cory: In Maryland our results have been somewhat similar to those in Ohio, but we were unable to get lasting effects with miscible oil. During the last two seasons when the weather has been very hot, the mite has increased to such an extent that it has caused serious damage and the ordinary summer sprays in dry weather have caused considerable burning.

President J. G. Sanders: Did you try self-boiled lime sulphur?

Mr. E. N. Cory: We used it in one orchard this year with fair results.

Mr. Philip Garman: In Connecticut we tried several different sprays and we had fair success, as a summer spray, with lime sulphur with nicotine added. We also had good success with soap solution—fish oil soap and ordinary laundry soap. There was a third combination devised for the control of red spiders on cucumbers in Massachusetts, known as "linseed oil emulsion." The latter spray, I think, gave as good control as anything I have ever seen.

President J. G. Sanders: Is not that emulsion rather expensive?

Mr. Philip Garman: The cost will not amount to very much more than lime sulphur. The total cost was about $1.50 per hundred gallons.

President J. G. Sanders: The next paper is "The Insecticidal Properties of Tobacco Dust," by P. J. Parrott and Hugh Glasgow.

THE INSECTICIDAL PROPERTIES OF TOBACCO DUST

By P. J. Parrott and Hugh Glasgow, *Geneva, N. Y.*

Abstract

Commercial tobacco dusts vary greatly in nicotine content and physical properties, the finer dusts killing a larger percentage of the spirea aphis, the currant aphis and the apple red bug. Rosy aphis was combated effectively with either nicotine sulphate

or tobacco dust in lime sulphur and glue sulphur sprays. Considerable trouble was encountered with certain types of spraying machines from clogging of the nozzles and strainers. Pumps with poppet valves and rather coarse strainers gave less trouble. Fine tobacco dust undiluted or with 10 percent of lime hydrate showed marked toxicity. The insecticidal properties of tobacco dust, on an average were not uniformly as high as that of dust mixtures containing nicotine sulphate. The concentrated tobacco solutions are apparently more economical than powdered tobacco.

Tobacco dust has long been employed to combat certain injurious insects, but very little data, apparently, are available dealing with its insecticidal properties and range of usefulness for the protection of garden, field or orchard crops. In the literature disseminated by agricultural institutions, various commercial extracts in concentrated form such as nicotine sulfate or nicotine solution are commonly recommended. Usually little, if any, mention is made of powdered tobacco.

During the course of our studies relative to susceptibility of sucking insects to dusting preparations, provision was made for a number of tests to determine the killing properties of tobacco dust incorporated in dusting and spraying mixtures. The present paper deals with some of the more important facts gained from these experiments.

The Nicotine Content and Physical Properties of Tobacco Dust

In the Virginia Station Bulletin 208, Ellett and Grisson state "that the nicotine content of tobacco varies greatly, depending upon many factors. The fertility of the soil and the kind of soil both have influence. In curing, the temperature is often allowed to run too high and nicotine is lost by volatilization. To ascertain the amount of nicotine, chemical analysis is required." The nicotine content of Virginia tobacco is as follows: stems, 0.48 to 0.60 percent; sweepings, 0.73 to 0.88 percent; N. L. Orinoco, 5.35 to 5.62 percent; olive, 3.63 percent; light, 2.9 percent; smoker, 2.30 percent; wrapper, 3.05 percent; cutter, 3.46 percent; dark, 2.83 percent; medium smoker, 3.76 percent; and common smoker 2.47 percent. "Stems had less nicotine content than leaves and dark varieties of tobacco, as Narrow-leaf Orinoco and Burley, had higher ratios of nicotine than bright or flue-cured types."

There is, apparently, no standard for tobacco dust either with respect to nicotine content or physical condition. In comparison with the foregoing figures, it is interesting to note that analysis of various lots of tobacco dust purchased in the State of New York showed considerable variation in nicotine, as follows: Sample 1, 0.88 percent nicotine; Sample 2, 0.58 percent; Sample 3, 0.50 percent; Sample 4, 0.95 percent; Sample 5, 0.98 percent; and Sample 6, 1.00 percent.

A few grades of tobacco dust purchased during the past summer were quite fine, but the larger number of samples contained a considerable amount of coarse material. Most preparations consisted of fine and coarse particles in varying proportions. A common constituent of tobacco was clay or dirt or other cheap adulterant substance or filler.

In our experiments we used a tobacco dust which was guaranteed to contain 1 percent nicotine. The physical properties of tobacco dust were as follows: Less than 50-mesh screen, 18 percent; 50-mesh, 27 percent; 100-mesh, 1 percent; 150-mesh, 10 percent; and 200-mesh, 44 percent.

To obtain larger amounts than were available of the more finely pulverized material, the tobacco dust was ground for six hours or more in a ball machine. This is not an entirely satisfactory outfit for the purpose because of the large amount of time required for grinding and its failure to pulverize completely all the coarse particles. Regrinding, even with this machine, did improve greatly the physical properties of common grades of tobacco dust. This is shown by comparing the foregoing figures relative to untreated tobacco dust with the accompanying analysis of a sample which was subjected to grinding for several hours:—Less than 50-mesh, 1 percent; 50-mesh, 11 percent; 100-mesh, 2 percent; 150-mesh, 12 percent; and 200-mesh, 74.5 percent. Supplies of tobacco dust of different degrees of fineness were obtained by passing the reground material thru screens of designated sizes. In the spraying operations the reground tobacco dust was always used, and even with this, considerable difficulty was sometimes experienced in maintaining a uniform discharge of the spray because of the clogging of the suction strainer and unseating of the ball valves.

Experiments with the Spirea Aphis

In this series of tests reground tobacco was compared with dust mixtures containing 1 percent nicotine. Sheets were attached firmly to the collar of each plant and "tanglefoot" was applied to the edges of the sheets to prevent the insects from escaping. Thoro applications of both kinds of dust materials were made. Twenty-four hours after treatment the number of dead and live insects were counted. With the exception of the coarser grades of tobacco dust all or a majority of the aphids were usually dislodged by the applications, and there is little doubt that the plants received greater protection than is indicated by the recorded killing efficiencies. The data are presented in Table 1.

Table 1. The Effect of Applications on Spirea Aphis

	Number of insects	Percentage of aphids killed
Reground tobacco dust, less than 50-mesh	778	8.5
Reground tobacco dust, 50-mesh	747	16.3
Reground tobacco dust, 100-mesh	1036	73.7
Reground tobacco dust, 150-mesh	1019	76.8
Reground tobacco dust, 200-mesh	1391	89.7
Reground tobacco dust, 100-mesh with 10-percent lime hydrate	1018	78.0
Reground tobacco dust, 150-mesh with 10-percent lime hydrate	979	83.0
Reground tobacco dust, 200-mesh with 10-percent lime hydrate	1566	84.0
Kaolin with 1 percent nicotine	1699	98.8
Lime carbonate with 1 percent nicotine	1706	99.1
Lime hydrate with 1 percent nicotine	1475	96.8
Sulfur with 1 percent nicotine	1681	96.8

Experiments with the Currant Aphis

Dust mixtures were applied at the rate of 1 pound per bush and spray mixtures at the rate of 2⅓ gallons per bush. Three applications were made to all the plats. With the possible exception of the sulfur-lead-arsenate dust containing 0.5 percent nicotine, the various preparations proved about equally effective in protecting currants from important curling of the foliage. At the conclusion of the period of infestation counts were made of the healthy and injured leaves on each bush. The data are given in Table 2.

Table 2. Effectiveness of Spray and Dust Mixtures in Controlling the Currant Aphis

Treatment	Percentage of injured leaves per bush
Spray (1 pint nicotine sulfate with 6 lbs. soap to 100 gals. water)	1.01
Dust (90–10 mixture with 0.5 percent nicotine)	2.82
Dust (90–10 mixture with 1.0 percent nicotine)	.41
Dust (90–10 mixture with 2.0 percent nicotine)	.13
Dust (reground tobacco containing 1.0 percent nicotine)	.20
Check No treatment	27.16

Experiments with the Rosy Aphis

In this series of tests a number of Greening trees were dusted with reground tobacco and others were sprayed with lime-sulfur at the usual dilution containing tobacco dust. For purposes of comparison, applications were made of lime-sulfur carrying nicotine sulfate and dust

Table 3. Influence of Delayed Dormant Application of Dust and Spray Mixtures on Rosy Aphis

Number of plat	Treatment	Number of trees examined	Average No. of apples per tree	Average No. of aphis apples	Percentage aphis apples
1	Spray (tobacco dust, 40 lbs. per 100 gals. of sulfur-glue mixture)	8	2207	43	1.95
2	Spray (tobacco dust, 40 lbs. per 100 gals. of lime-sulfur 1–40)	8	867	22	2.65
3	Spray (tobacco dust, 25 lbs. per 100 gals. of lime-sulfur 1–40)	8	925	11	1.25
4	Spray (nicotine sulfate, ¾ pint per 100 gals. of lime-sulfur 1–40)	32	1086	20	1.99
5	Dust (reground tobacco dust, 5 lbs. per tree)	8	1408	261	19.02
6	Dust (90–10 mixture with 2 percent nicotine)	12	1735	324	19.16
7	Dust (90–10 mixture with 1 percent nicotine)	12	1211	347	27.73
8	Dust (90–10 mixture with 0.5 percent nicotine)	14	1797	487	29.74
9	Check	4	2225	719	32.31

mixtures consisting of sulfur-lead-arsenate (90–10 formula) with 0.5, 1, and 2 percent nicotine, respectively. The materials were applied as the apple buds were opening and the aphids were appearing on the tips of the young leaves. The effectiveness of the different mixtures in protecting fruits from injury is indicated in Table 3.

Experiments with the Apple Red Bug

The applications of dust and spray mixtures were made to Greening apples when the petals had dropped from the trees. The experiments were conducted in two different orchards. The methods followed in these experiments, the selection of dust and spray mixtures, and principal results are clearly indicated in Tables 4 and 5.

Table 4. Comparative Susceptibility of Red Bug Nymphs to Dusting and Spraying Mixtures

Material	Number of trees examined	Amount of material per tree	Average No. of insects dislodged		Average percentage killed
			number living	number dead	
Reground tobacco dust	1	8 lbs.	12	186	93.9
Sulfur-lead-arsenate dust, 0.5 percent nicotine	3	2 lbs.	18	59	78.8
Sulfur-lead-arsenate dust, 0.5 percent nicotine	2	5 lbs.	52	988	95.0
Sulfur-lead-arsenate dust, 1.0 percent nicotine	3	2 lbs.	27	94	73.3
Sulfur-lead-arsenate dust, 1.0 percent nicotine	2	5 lbs.	0	155	100.0
Sulfur-lead-arsenate dust, 2.0 percent nicotine	4	5 lbs.	0	199	100.0
Spray (tobacco dust 40 lbs. per 100 gals. lime-sulfur 1–40)	1	15 gals.	1	331	99.7
Spray (tobacco dust 40 lbs. per 100 gals. lime-sulfur 1–40)	1	25 gals.	4	185	97.9
Spray (nicotine sulfate 1 pint in 100 gals. lime-sulfur 1–40)	1	7½ gals.	17	349	95.4
Spray (nicotine sulfate 1 pint in 100 gals. lime-sulfur 1–40)	1	15 gals.	1	478	99.8
Spray (nicotine sulfate ¼ pint in 100 gals. lime-sulfur 1–40)	1	15 gals.	39	162	80.6
Spray (nicotine sulfate ¼ pint in 100 gals. lime-sulfur 1–40)	1	25 gals.	21	86	80.4

Table 5. Comparative Susceptibility of Red Bug Nymphs to Dusting Mixtures

Material	Amount per tree	Number of insects dislodged		Percentage killed
		number living	number dead	
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	26	888	97.2
Reground tobacco dust with 10 percent lime hyrdate	5 lbs.	28	395	93.4
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	9	188	95.4
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	5	19	79.2
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	8	52	86.7
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	27	424	94.0
Reground tobacco dust with 10 percent lime hydrate	5 lbs.	9	151	94.4
Reground tobacco dust with 10 percent lime hydrate	10 lbs.	7	321	97.9
Tobacco dust	5 lbs.	15	223	93.7
Tobacco dust	5 lbs.	5	174	97.2
Lime hydrate with 2 percent nicotine	5 lbs.	1	201	99.5
Lime hydrate with 2 percent nicotine	5 lbs.	1	220	99.5
Summary				
Tobacco dust with 10 percent lime hydrate	5 lbs.			91.5
Tobacco dust with 10 percent lime hydrate	10 lbs.			97.9
Tobacco dust	5 lbs.			95.5
Lime hydrate with 2 percent nicotine	5 lbs.			99.5

Summary

Commercial grades of tobacco show a lack of standardization since they vary greatly in nicotine content and physical properties.

In experiments against the spirea aphis reground tobacco (1 percent nicotine) of 100, 150 and 200-mesh fineness killed a larger percentage of the insects than the coarser grades of the material.

Fine tobacco dust displayed a high rate of toxicity against the spirea aphis, the currant aphis and the apple red bug. Its insecticidal properties, on an average, were not uniformly as high as that of dust mixtures containing nicotine sulfate.

The rosy aphis was combated effectively with either nicotine sulfate or tobacco dust incorporated in lime-sulfur and glue-sulfur sprays. Unpublished data record similar results with the casein-sulfur spray. In comparison, dust mixtures consisting of or containing tobacco dust and nicotine sulfate as killing agents gave less efficient control of the insect.

Considerable trouble was encountered with certain types of spraying machines from clogging of the nozzles and strainers, as well as unseating of ball valves thru the accumulation of tobacco dust in the valve seats. Less difficulty was experienced with pumps equipped with poppet valves and rather coarse strainers.

Fine tobacco dust, undiluted or mixed with 10 percent of lime hydrate, displayed very desirable physical properties for dusting purposes.

In view of the data presented, it is concluded that tobacco dust possesses marked insecticidal properties. The season's results also suggest that it could doubtless be used with great advantage for combating a number of common injurious insects.

Considering present prices of commercial brands of tobacco extracts and tobacco dust in relation to nicotine content, the concentrated solutions are apparently more economical than powdered tobacco.

Data are needed relative to the utility of tobacco dust as an insecticide for specific pests and its economy in comparison with other tobacco preparations.

President J. G. Sanders: We will now hear a paper entitled "Some Further Experience with Nicotine Dusts," by T. J. Headlee.

SOME FURTHER EXPERIENCES WITH NICOTINE DUSTS

By T. J. Headlee, *New Brunswick, N. J.*

(Withdrawn for publication elsewhere)

Mr. William Moore: One reaction of nicotine not generally recognized is its ability to unite with carbon dioxide of the air, to form nicotine carbonate. This reaction occurs under moist conditions, but free nicotine would be again liberated under dry and warm conditions. The reaction is similar to that of ammonium carbonate.

Session adjourned 5.30 p. m.

Scientific Notes

Practical Control of Eleodes hispilabris Over an Extensive Area. Experiments in 1921 that were successful in the control of Eleodes adults over a small area were repeated on a much larger scale in 1922. Experiments were in cooperation with farmers and the area treated embraces approximately 18,000 acres. It was further demonstrated that control is practical and economical by poisoning the beetles soon after emergence and before they have had an opportunity to lay eggs that produce the succeeding generation. Beetles emerge in July and August and do not oviposit until the following May. A poison mash made of bran, Paris green, amyl acetate and water distributed broadcast or in the bottoms of furrows plowed at regular intervals killed the beetles effectively at a cost of about 2½c per acre for materials. One man and a team and driver readily treated 320 acres per day. One cooperator combined the plowing and distribution in one operation thus greatly increasing the acreage treated per day. Results were directly proportional to thoroughness of application. Where the individual farmer was sincere and painstaking in his work almost complete eradication of the beetles was obtained.

Claude Wakeland,
Experiment Station Entomologist, University of Idaho.

Introduced mite attacking Willow. During August, 1922, the attention of the writer was called to a heavy mite infestation on willow, *Salix alba*, at Chambersburg, Pa.

The mites were not only on the leaves but had spun their webs over the main trunk of the tree almost to the ground and over all the limbs so that the tree had a peculiar light shining appearance. An adjoining black willow was also infested altho not so heavily.

Specimens of the mite were sent to Dr. Ewing who identified them as *Schizotetranychus schizopus* Zacher. The only reference the writer could find to this species is contained in a paper by E. A. McGregor in Vol. 56, Proc. of the U. S. Nat. Mus., 1919. It has been recorded only from Germany. Zacher found it on several species of willow at Dahlem, Germany, and described it in 1910. It is of interest to note that *Salix alba* is an introduced species of willow.

J. R. Stear,
Chambersburg Laboratory, Penna. Dept. of Agriculture

"Fire Ant" Injurious to Potatoes in California.—While conducting field investigations in the upper or southern part of the San Joaquin Valley, I was told by the proprietor of a hotel that a stinging ant was destroying potatoes in the vicinity of

Wasco. An examination of the potato vines growing in sandy soil showed numerous ants tunneling in the stalks on April 16, 1919. In all probability, the potatoes were planted in the favorite nesting grounds of this ant.

Prof. W. M. Wheeler determined the ant as a subspecies of the common "fire ant" (*Solenopsis geminata* Fabr. subsp. *maniosa* Wheeler) and states that it is abundant in Southern California, especially in the environs of Santa Barbara, Pasadena and Los Angeles, in the Southern States and the tropics in general. It has on many occasions been seen to eat green vegetable matter, even strawberries, tender shoots etc., so that I am not surprised that you should have found it tunneling in potato plants. It is also a seed-storing ant. It usually nests in open, sunny, sandy places. This ant stings badly, hence its name "fire ant." In Texas I have known the common form to kill young chickens.

HENRY H. P. SEVERIN, Ph.D.
California Agricultural Experiment Station

Dengue Fever and Mosquitoes in the South. A severe epidemic of dengue fever swept the Southern States during the present season. This outbreak is probably the most severe the South has ever experienced, or at least the worst which has occurred in many years. While there have been comparatively few deaths due to the malady there has been tremendous economic loss and much individual suffering.

According to morbidity reports the disease first appeared in Florida the latter part of May, and that state showed a large number of cases throughout the season. The number of cases reported reached the maximum during the latter part of September, although October reports are not available. The disease apparently entered Georgia from the south, being first recorded in that state on August 19. The disease was also recorded in Texas rather early in the season, the first cases (200) being reported from Galveston on July 17. From that point and other southern Texas cities the malady was soon introduced into various parts of Texas, and a great number of cases occurred, especially in the larger centers. In Dallas, for instance, up to November 1st a total of 3,476 cases were reported. Dengue was first reported in Alabama on August 26, in Louisiana on September 2, South Carolina on September 16, Mississippi on September 30, and Arkansas on October 7. At least a few cases of the disease also appeared in Oklahoma late in the season and some were also unauthentically reported from Tennessee.

The yellow fever mosquito (*Aedes aegypti*) has been shown to be an effective carrier of this malady and it is probable also that *Culex quinquefasciatus* may be concerned. The former species was present throughout the Southern States in considerable numbers during the summer and fall, although apparently not much more numerous than usual. *C. quinquefasciatus* was also abundant, at least in some localities, but usually it is not as frequent an intruder in the house as the yellow fever mosquito.

F. C. BISHOPP

A Repellant For Flat Headed Borers. For many years we have been searching for some repellant that will exclude flat-headed borers from apple and other trees. As a result of this search we have finally hit on the following mixture which seems to fill the requirements of the situation inasmuch as in our tests during three years just past the exclusion of borers has been practically complete.

During 1922 the formula stood as follows:—

Common laundry soap	50 pounds
Water	3 gallons
Flake naphthaline	25 pounds
Flour	2 pounds

Place the soap in the water over steam-pipes and allow it to soften for a few days. Use a potash soap which will form a smooth mixture, not a soda soap since the latter becomes jelly-like. Then place in a double boiler (we use a medium sized wash-boiler placed inside a very large one) and cook until the temperature reaches 180° Fah. Stir in the flour and add the naphthaline and bring the temperature to 180° Fah. at which temperature the naphthaline will have melted, the melting point of naphthaline being 176°, then cool as quickly as may be, stirring the mixture occasionally.

The more rapidly the mixture is cooled the smaller will be the crystals of naphthaline.

In our experimental work this mixture was made up during the winter and stored in air-tight drums. It should be applied with a brush after warming and thinning slightly to the consistency of heavy cream. In our trials, applications were made every three weeks beginning on June 1st, and in no case thus far has any injury to the trees resulted. At the same time almost no flat-heads have been found in trees so protected although they abounded in the checks and in some cases had done very serious injury to young trees in the same orchards previous to the application. Our tests have covered a period of about four years and have been made on several thousand trees.

It seems likely that it will be possible to extend the interval between treatments without losing a reasonable insurance against attack and perhaps the same treatment will protect other borers of the trunks and limbs of various trees.

R. H. Pettit
Michigan Agricultural College

A Parasite of the European Rose Slug Egg. The European rose slug, *Caliroa aethiops* Fabr., is very destructive to rose bushes in Lawrence, Kansas, every season. It renders most unsightly all bushes that have not been protected by sprays. In early May, 1919, my attention was called to the fact that a large number of the egg blisters were brown, or shiny black. Many egg-bearing leaves were gathered and brought to the laboratory for study. From these black shiny eggs there emerged the little wasp parasite that has been determined for me by Mr. Rohrer, as *Trichogramma minuta* Riley. This parasite has been reported from eggs of *Aletia argillacea, Odontota suturalis, Plusia brassicae, Heliothis armigera, Papilio glaucus, Vanessa atalanta, Basalarchia archippus* and *Pteronidea ribesi*; the last, of course, a sawfly.

The eggs of the rose sawfly on one hedge of rose bushes, were quite commonly parasitized, counts showing about twenty-five per cent parasitism. Many other sections of the town were examined, but no parasitized eggs found. Each summer since 1919, we have looked carefully for parasitized eggs on the hedge where they had been found and elsewhere, but so far, have not taken any parasites.

The parasitic wasps emerged from parasitized eggs brought in from the bushes, in from one to six days. From one to three wasps issued from each egg. On several occasions I witnessed the emergence by means of the binocular microscope. From one egg, three came forth, one following the other in quick succession. The tiny

wasp cuts its way from the egg shell with its mandibles. The time required for the process in one case was thirty-five minutes from the time the first puncture of the egg shell occurred until the wasp emerged. Where there are more than one wasp in the egg, the second wasp sometimes enlarges the exit hole before attempting to pass. As soon as the wasp comes forth and while the wings are still pads, it can jump an inch with alacrity. The wings fill out in about four minutes. The parasitized egg first turns brown, then shining black. The parasite emerges through a ragged circular hole about one-fourth the diameter of the egg blister while the slug in hatching comes through by making a large crescentic rent in the shell. It is thus possible to include the abandoned eggs in the counts for parasites.

H. B. Hungerford,
University of Kansas, Lawrence, Kansas

Rice Weevil. It has been known that the rice weevil, *Sitophilus oryza*, can cut holes through shuck coverings of corn. These holes, however, appeared to be made chiefly in storage. During early December 1922, the writer observed weevils in the field cutting their way out through a relatively tight fitting shuck covering. A slight opening at the tip of the ear had permitted the entry of a weevil which had penetrated to the base of the ear where it had evidently deposited numerous eggs. The second generation of adults upon emerging from the kernels found themselves confronted with a closely applied shuck covering through which they proceeded to cut their way to the outside. Upon reaching the more loosely fitting outer leaves of the shuck, certain of the weevils crawled unobstructed to the tip of the ear and thus gained freedom, but others much closer to the base were forced to cut their way through each layer of the shuck covering before leaving the ear.

S. E. McClendon,
Field Assistant in Insect Control, Bureau of Entomology, U. S. Dept. Agr.

Rhagoletis tabellaria Fitch. What appears to be a new record for this insect is the finding of the larvae in the fruit of the Western Tall Blueberry in western Washington. On August 15, 1918, while making a trip by automobile from Aberdeen to Markham, Wash., the writer found some tall-growing blueberries in the woods a little way from the narrow road near Markham. The plants here were rather few in numbers and scattered, and were rather sparsely set with berries. On examination these berries proved to be heavily infested with maggots said by the people in that locality to be quite common in blueberries. Some were collected and subsequently placed on slightly moist sand in an insectary. These larvae pupated on August 20, 1918, and adults emerged during the summer of 1919. These have been determined by Dr. J. M. Aldrich of the U. S. National Museum as *Rhagoletis tabellaria*, which was originally described by Fitch in 1855 from specimens collected in New York.

H. K. Plank

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1923

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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Attention is called to some changes in reprint rates, see the usual paragraphs printed above.

The abstracts appearing in this issue were prepared by the editor and have the approval of the various authors. This method was adopted simply that we might start on a general plan designed to make all biological literature more accessible. Authors are urged to prepare abstracts for future articles, it may be required later, even if the papers are in the editor's hands at the present time. The abstract might well include or take the place of the summary and should be so written as to give a comprehensive and accurate idea of the contents of the paper. Prepare it in such a way that abstract journals can do no better than reprint it, and the indexer have no difficulty in locating the important topics or subjects. Employ concise though complete sentences and distinguish clearly between compilations or digests and contributions to knowledge. Do not overlook methods whenever they are of importance. Get all this within approximately five percent of the length of the paper. The editor welcomes criticisms or suggestions in relation to this departure. He regrets that it may be impossible to please all.

One of the items of business at the recent meeting of the Association was the reading of an invitation to an "International Conference of Phytopathology and Economic Entomology" to be held at Wageningen, Holland, next June (25th to 30th).

It is good that such a conference has been called; and Wageningen will be an excellent meeting place, since it has been the headquarters of

the Holland Phytopathological Service for many years, under the leadership of Dr. Ritzema Bos. International team work and cooperation between the economic entomologists and the phytopathologists is becoming almost daily more important, and this fact is strongly realized in the United States, as is indicated by the extremely interesting symposia that have been held now for three years in succession by the American Association of Economic Entomologists and the American Phytopathological Society; and it is greatly to be hoped that American entomologists and phytopathologists will be present at the coming conference.

A notable fact connected with this announcement is that in its title phytopathology and economic entomology are coördinately mentioned. This, we think, is the first time that this has happened in the recent development of agricultural science in Europe. And it is a good step. The agricultural entomologists of several European countries have not thoroughly approved of the fact that they were considered as belonging to a subordinate branch of a phytopathological service, and have felt that their organizations should be explicitly designated as intended for the investigation of problems relating to phytopathology *and* economic entomology (or the reverse). In America, the economic entomologists have their own independent official organizations and their own independent societies, and Europe will undoubtedly come eventually to the same arrangement. This conference is notable, therefore, as the first step in this direction. It is interesting to note that in the founding of the Société de Pathologie Vegetale de France the economic entomologists joined in for the reason that they were not sufficiently numerous in that country to start their own organization and have since been outvoted as to its title by the more numerous botanists. The whole subject has received a vigorous discussion in Germany, where the economic entomologists founded their own organization after the return of Escherich from America, three years before the World War.

Reviews

Entomology with Special Reference to its Ecological Aspects by J. W. Folsom. Third edition with five plates and 308 text figures, pp. I-VII, 1-502. P. Blakiston's Son and Co., 1922.

The third edition of this standard work bears evidence of thorough revision, including a great deal of new material and a few new illustrations and like its predecessor has been reset. The chapter on "Classification" reflects the latest develop-

ments along this line and the same is true in other portions of the work. The most important change is the addition of a comprehensive and very suggestive chapter on "Insect Ecology," a phase of biology of fundamental importance to economic entomologists. Some 250 new titles have been added to the bibliography, some of the less important in the earlier editions being discarded.

We have in this volume, as in the preceding editions, a most admirable summary of the fundamentals of insect biology and ecology with special reference to its ecological, really economic applications. In effect it constitutes a ready reference work and index to the vast literature summarized in this work. It is an invaluable supplement to our somewhat numerous taxonomic volumes and stands in a class by itself. Doctor Folsom has rendered an invaluable service in bringing his work down to date and we do not hesitate to commend most highly this latest edition to entomologists, especially economic entomologists who should be primarily concerned with biological relations and their practical applications. The price of this work is $4.00.

E. P. F.

Om Oksebremsens Bekaempelse (Fight against the Ox Warble) by Dr. Laust Brodersen. Maanedsskrift for Dyrlaeger (Copenhagen), Vol. 34, Pt.13 Oct.,1922.

The facility with which the ox warbles (*Hypoderma* spp.) can be greatly reduced in numbers is mentioned by the author. The situation of Denmark is favorable to entire eradication of this pest in that country provided a concerted fight should be made against it. The Minister of Agriculture proposed a law last winter looking toward the eradication of the pest throughout the country. While this proposal was received favorably by the lawmaking body it was deemed desirable not to press its passage at that session owing to the danger of the spread of foot and mouth disease by those carrying on the work.

After discussing the various methods of destroying the ox warble and pointing out their difficulties and objections, the author stresses the advantages of an instrument for mechanically removing the larvae or grubs, which he and an engineer of Copenhagen have perfected.

The instrument consists of a brass pump about the size of a small garden hand sprayer. This is arranged with piston and valves calculated to create a partial vacuum. The lower end of the pump is provided with a suction bell of rubber which is applied to the animal over the warble hole. As this is firmly pressed against the warble the handle of the pump is pulled out and the combined pressure and suction removes the larva as well as the pus which surrounds it. He states that in some instances the larvae come out with a single stroke of the pump while in other cases several strokes are necessary.

Before beginning extraction the hide on the back of the animal is rubbed with soapy water to facilitate extraction.

The author states that he has tested this device in extracting about two hundred and twenty larvae from thirty-five animals in different localities. Most of those extracted were in the later stages of development but the author believes that the younger ones could be removed in the same way.

The writer of this review is of the opinion that Dr. Brodersen has made a notable contribution to this field of work in devising this mechanical warble extractor.

It is, of course, desirable that the instrument be tried out on a very large scale, especially with different breeds of cattle, some of which are known to have characters of hide which make grub extraction very difficult. If the instrument works successfully under all conditions it would commend itself on account of the greater cleanliness of the work, lessening the chances of bruising the tissue and possibly producing less pain to the animal, as well as its ability to remove the pus from the cysts.

F. C. Bishopp,
United States Bureau of Entomology

Current Notes

Dr. A. L. Quaintance of the Bureau of Entomology accompanied Secretary Wallace to the Cotton States Conference, held at Memphis, Tenn., December 5, 1922.

Professor William M. Wheeler gave the annual public address of the Entomological Society of America, December 27, at Boston, on "The Physiognomy of Insects.'

Mr. C. A. Weigel of the Bureau of Entomology gave an address on greenhouse insects before the meeting of the Philadelphia Florists' Club, on November 7.

Professor H. A. Gossard read a paper before the National Nut Growers' Association, Thomasville, Ga., October 4, 1922, on "The Pathway of Progress for the Pecan Grower."

Dr. Henry Skinner was elected vice president and Mr. James G. A. Rehn recording secretary of the Philadelphia Academy of Natural Sciences at the annual meeting, December 19, 1922.

Mr. G. F. Moznette of the Bureau of Entomology was scheduled to give an address at the State Conference on mosquito eradication held at Daytona, Fla., December 6, 1922.

Mr. A. J. Ackerman of the Bureau of Entomology, with headquarters at Bentonville, Ark., planned to attend the annual meeting of the Missouri State Horticultural Society at Joplin, December 13-15.

Professor R. N. Lobdell, associate professor of zoology and entomology and assistant entomologist at the Mississippi College and Station, has been assigned to full-time work on the Station staff as zoologist.

Mr. C. P. Lounsbury, Entomologist of the Union of South Africa, who has been in official entomological work at Cape Town for twenty-six years, has been visiting for several months in the United States.

Dr. Seymour Hadwen returned to Ottawa the latter part of November, after spending several months in Europe, where he studied particularly the Reindeer situation in Lapland, for the United States Department of Agriculture.

Dr. L. O. Howard, Chief of the Bureau of Entomology, and Professor C. T. Brues, Assistant Professor of Economic Entomology at Bussey Institution, gave addresses at the Symposium before Section N (Medical Sciences) at the Boston meeting.

Mr. W. L. McAtee of the U. S. Biological Survey, was scheduled to give a lecture on the work of the Biological Survey at the University of Indiana during his annual vacation which began on October 30.

Mr. G. A. Runner of the Bureau of Entomology, stationed at Sandusky, Ohio, attended the meeting of the Michigan Horticultural Society, the middle of December, and presented a paper on the grape berry moth and its control.

Mr. O. I. Snapp of the Bureau of Entomology with headquarters at Fort Valley, Ga., attended the annual meeting of the Mississippi State Plant Board, held at Agricultural College, Miss., and discussed peach insects and their control.

On December 4, Dr. L. O. Howard, Chief of the Bureau of Entomology, gave a lecture at the school of hygiene and preventive medicine of Johns Hopkins University on the subject of "Medical Entomology and Public Health."

Mr. R. C. Twinn was appointed Junior Entomologist, Entomological Branch, Canadian Department of Agriculture, and reported for duty at headquarters early in October. Mr. Twinn will devote the greater portion of his time to the establishment of the Crop Pest Record.

Dr. L. B. Uichanco, who has been on a traveling fellowship for three years, during which time he has studied at Bussey Institution, Harvard University, has been appointed Professor of Entomology, College of Agriculture, Los Banos, P. I., and has returned to the Philippine Islands.

Some scouting work for the gipsy moth was carried on in certain sections of Ontario and the eastern townships of Quebec. Inspectors Finnamore and Fowler were engaged on this work, and were assisted in Ontario by provincial officers. Fortunately no sign of the gipsy moth was found.

Mr. Dexter H. Craig, field assistant in insect control, attached to the corn-borer investigations, Bureau of Entomology, resigned from the service, effective September 11, for the purpose of entering a commercial school. Mr. Craig expects eventually to enter a large manufacturing concern in an executive capacity.

Dr. B. A. Porter of the Bureau of Entomology, Mr. G. E. Saunders, Manager of the Deloro Chemical Company, Deloro, Ontario, Canada, and Messrs. P. Garman, M. P. Zappe and W. E. Britton of the Connecticut Agricultural Experiment Station are entomologists who gave addresses before the Connecticut Pomological Society at Hartford, Conn., December 13.

Mr. G. H. Hammond, Entomological Branch, Canadian Department of Agriculture who has been serving in a seasonal capacity in Ottawa during the past summer, has been granted the Memorial Scholarship given by the Macdonald College Agricultural Alumni Association for 1922–23. He terminated his appointment with the Branch on November 23d.

In a course of lectures on scientific subjects to be given in the Educational Building under the direction of the New York State Museum, Albany, Dr. E. P. Felt is on the program for two lectures as follows: January 26, "Origin and Evolution of the Insects;" March 2, "Insects and Wireless."

A conference was held at Agricultural College, Miss., November 27–29, to consider additional steps to be taken in the eradication of the sweet-potato weevil in

southern Mississippi. This conference was attended by K. L. Cockerham, F. A. Wright, Troy Thompson, and F. R. White, of the Bureau of Entomology, and various State officials.

Professor F. H. Lathrop, associate professor of entomology and assistant entomologist of the Oregon College and Station has been appointed to the Sulphur fellowship of the Crop Protection Institute, which has been placed under the supervision of the New York Agricultural Experiment Station at Geneva. Professor Lathrop entered upon his duties September 1, 1922.

Dr. A. L. Quaintance, in company with Professor J. J. Davis and W. P. Flint and Mr. A. J. Ackerman, recently made an investigation of the San Jose scale situation in orchards in southern Indiana and Illinois. The scale was found to be very abundant and destructive in some orchards and growers are thoroughly alive to the necessity of energetic remedial measures if the orchards are to be saved.

Mr. E. R. Buckell who was recently appointed as an Assistant Entomologist, Entomological Branch, Canadian Department of Agriculture, reported for duty on November 27th, coming direct to Ottawa from British Columbia. He is now engaged in preparing a report on the influences of grasshoppers on the range. He reports that the most serious outbreak of grasshoppers in the history of the Province occurred during the past year.

Very excellent collections of insects have recently been received from the Rev. W. W. Perrett, Labrador; Mr. C. H. Crickmay from the Fort Norman district; and from Mr. J. Russell, of the Topographical Surveys Branch, Department of the Interior, Ottawa, the latter from the Great Slave Lake region. All of these collections contain material which is new to the Canadian National Collection, and will prove most valuable to the student of the arctic fauna.

Mr. C. H. Curran has been appointed Assistant Entomologist, Entomological Branch, Canadian Department of Agriculture, and attached to the Division of Systematic Entomology. He reported for duty in Ottawa on September 28th. Mr. Curran is a specialist in the Diptera, and has been working on Asilidae, Bibionidae and Stratiomyidae. Officers in charge of Canadian laboratories are urgently requested to send in as soon as possible any material they may have in any of the above families.

The European corn borer scouting work was completed in southern Ontario on September 23d. During the season 165 townships were scouted, of which 45 were found infested and later quarantined. The corn borer has spread over Essex, Kent, Lambton and part of Huron Counties, as well as along the Lake Ontario shore as far east as Brighton. Seven evasions of the quarantine were discovered by Inspector Ryan, six of these were prosecuted and five convictions secured.

Mr. James Zetek, in charge of the field station of the Bureau of Entomology at Ancon, Canal Zone, reports that F. X. Williams, an entomologist of the Hawaiian Sugar Planters' Experiment Station, spent a week at the field station. He left for Ecuador, where he hopes to find the parasites of the sugar-cane wireworm. Should he fail there, he intends to return to the Canal Zone and go to the interior of Panama, where favorable facilities for his work have been procured.

Mr. R. T. Cotton, Bureau of Entomology, recently investigated the Angoumois grain moth situation in Salem County, N. J., and in and about Charlottesville, Va. Wheat thrashed late in the season in these localities was very badly damaged. These examinations were a continuation of those made by Dr. Back and Mr. Cotton on the farms of Montgomery County, Md. In Montgomery County late-thrashed wheat was frequently found damaged from 40 to 90 per cent., while wheat thrashed directly after harvest showed less than 1 per cent. infestation.

Mr. L. S. McLaine left Ottawa on September 28th for a trip to the Maritime provinces and Boston, and returned to headquarters on October 16th. During his trip he arranged with the provincial authorities in New Brunswick and Nova Scotia the brown-tail moth work for this coming winter. He also visited nurserymen in Nova Scotia in connection with the apple sucker quarantine, and investigated certain matters relating to the fumigation and inspection work carried on in New Brunswick and Nova Scotia. During his visit to Boston, he interviewed the officials connected with the European corn borer and gipsy moth work.

Messrs. C. H. Popenoe, J. E. Dudley, Jr., R. E. Campbell, and J. E. Graf of the Bureau of Entomology attended the pea aphis conference in Chicago at the Sherman Hotel, November 9 and 10, for the purpose of arranging cooperative work on the insect in the interest of State Entomologists. The conference was largely attended by State Entomologists and representatives of canners. As a result of the meeting, recommendations governing future work on this insect were drawn up and endorsed by both entomologists and canners. Present plans contemplate establishing a large laboratory in one of the central states and cooperative tests with various State Entomologists in all important pea-growing sections.

The annual meeting of the Crop Protection Institute was held at Rochester, N. Y., January 11. Professors W. C. O'Kane, P. J. Parrott and W. E. Britton of the Board of Governors were present, and Professor O'Kane was elected Chairman for the coming year. At the dinner following the meeting, Professors W. C. O'Kane, P. J. Parrott, Lawson Caesar and Mr. H. L. Frost were speakers. Other entomologists present were Hugh Glasgow, and Dr. M. D. Leonard. The New York Horticultural Society held its annual meeting at the same time at Rochester and in addition to the entomologists mentioned above, Dr. E. P. Felt and Professors G. W. Herrick, C. R. Crosby and H. E. Hodgkiss were among those in attendance.

According to the October News Letter of the Bureau of Entomology, the Bureau now has 75 field stations, 71 of which are located in 33 states. Texas has eight, California and Florida six each, Louisiana, Mississippi and Oregon four each, Massachusetts has three and Alabama, Arizona, Georgia, New Jersey, New York, North Carolina, Pennsylvania, Tennessee, Virginia and Washington two each. Arkansas, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Missouri, Montana, Ohio, South Carolina, Utah, West Virginia and Wisconsin have one each, and there is one in the Canal Zone, one in France, one in Japan, and one in Hawaii.

Mr. C. H. Popenoe, Bureau of Entomology, returned from an inspection trip in the Estancia Valley in New Mexico where he conducted observations and made preliminary plans for work on the Mexican bean beetle. Arrangements were made for overwintering the beetles in outdoor cages under varying mountain conditions and for securing data the coming season on winter mortality and dispersal of marked

beetles from hibernation cages. Mr. Popenoe found that because of the extreme drought in that region the insect had not gone into hibernation as early as in previous years, and had become concentrated in localities not previously seriously infested. Because of the ravages of the beetles and of the improbability of securing a crop, the bean growers have been instructed to pasture off all bean lands containing growing plants, thereby reducing the number of the beetles successfully hibernating and, consequently, the next year's infestation.

The meetings of the Entomological Society of Ontario were held in Guelph on Friday and Saturday, November 24–25. The following members of the staff of the Entomological Branch, Canadian Department of Agriculture, attended the meetings: Messrs. Gibson, McLaine, Treherne, Ross, Crawford, Hudson, and Hutchings. The papers presented by officers of the Branch were: "Recent Developments in the Dominion Entomological Service," Arthur Gibson; "The Spread of the European Corn Borer in 1922," L. S. McLaine; "Ploughing as a Factor in Controlling the European Corn Borer," H. G. Crawford; "Mechanical Devices used in Control of the Strawberry Root Weevil," W. Downes; "Observations on the Oviposition of *Senotania trilineata*," C. H. Curran; "The Relationship of Biological and Taxonomic Studies of Syrphidae," C. H. Curran; "Notes on *Frankliniel'a tritici* Fitch," R. C. Treherne; "Biologic Notes on two Buprestid Beetles," C. B. Hutchings; "The Outbreak of the Grape Leaf-Hopper," W. A. Ross and W. Robinson; "Some Observations on the Oviposition of *Hypera punctata*," H. F. Hudson; "Recent Work on the Rose Chafer," W. A. Ross and J. A. Hall, and "The Occurrence of the Potato Seed Maggot in Ontario," G. H. Hammond.

The seventeenth annual meeting of the Entomological Society of America was held in Boston, Mass., in the Buildings of the Massachusetts Institute of Technology, on December 26, 27 and 29, 1922. The meetings were unusually well attended, the attendance ranging from about 75 to 250 in the different sessions. Seventy-four new members were elected during the past year, bringing the total membership to 652, the largest in the history of the Society. The following officers were elected: President, Prof. T. D. A. Cockerall, University of Colorado, Boulder, Colo.; First Vice-President, Dr. Wm. S. Marshall, University of Wisconsin, Madison, Wis.; Second Vice-President, Dr. F. E. Lutz, American Museum of Natural History, New York City; Secretary-Treasurer, Dr. C. L. Metcalf, University of Illinois, Urbana, Ill.; Managing Editor of Annals, Prof. Herbert Osborn, Ohio State University, Columbus, Ohio; Additional members of Executive Committee: Arthur Gibson, Dominion Entomologist, Ottawa, Canada; Dr. Wm. A. Riley, University of Minnesota, St. Paul, Minn.; Prof. R. A. Cooley, Agricultural Experiment Station, Bozeman, Mont.; Mr. Charles W. Johnson, Boston Society of Natural History, Boston, Mass.; Dr. E. P. Felt, State Entomologist, Albany, N. Y.; Prof. A. L. Melander, State College, Pullman, Washington. The Society voted to raise the annual dues from $2.00 to $3.00, effective January 1, 1924. Professor J. J. Davis of Purdue University was appointed Treasurer of the Thomas Say Foundation, to succeed Dr. E. D. Ball, resigned. Messrs. R. A. Cooley, R. W. Harned, and Guy C. Crampton were elected as new members of the Editorial Board of the Annals. The Society approved the constitution for the Union of American Biological Societies, as published in *Science* for September 29, 1922, and appointed A. N. Caudell and A. G. Boving as the representatives of the Society to attend such meetings as may

be called in Washington during the coming year. The following subject was selected for the Symposium at the Cincinnati meeting in 1923: "Methods of Protection and Defense Among Insects."

Horticultural Inspection Notes

Messrs. G. S. Langford and P. D. Sanders have been appointed to fellowships in the State Horticultural Department, University of Maryland, and a portion of their time will be devoted to regulatory matters.

Mr. L. R. Dorland, who formerly was in charge of the work of the Federal Horticultural Board at Del Rio, Texas, has exchanged ports with Mr. H. M. Cely, who for the past two years has been in charge of the Board's activities at Nogales, Arizona.

Mr. E. I. Smith, a graduate of the University of West Virginia, was temporarily appointed as Plant Quarantine Inspector to assist in the examination of plants arriving in Washington, D. C., under special permit during the months of December, January and February.

Professor E. N. Cory, State Entomologist of Maryland, reports that as high as ninety-seven per cent. of the foreign bulbs which have been inspected in Maryland during the present shipping season were found to be infested with mites; and in many instances, soft rot was present.

Inasmuch as plants bearing invalid certificates continue to arrive in the District of Columbia, it would appear that various state officials charged with the inspection of nurseries should take steps to prevent the further use of certificates of this type. A certificate dated "1912" was taken from a shipment arriving in Washington this season.

Mr. A. C. Fleury, Quarantine Officer in Charge at San Francisco, California, reports that oranges purchased in Japan, found in passenger's baggage arriving at that port ex. S. S. President Wilson in December were infected with Citrus Canker. Interceptions of this kind forcibly emphasize the need of careful examination of passenger's baggage, in cooperation with Customs officials, at ports of entry.

In a recent letter, Mr. A. C. Brown reported the following interceptions by inspectors of the State Plant Board of Florida: *Aleurocanthus woglumi* Ashby on spice leaves from Nassau, Bahama Islands; *Targionia hartii* Ckll. on yams from Havana, Cuba and Barbados, British West Indies; *Aspidiotus destructor* Sign. on palm from Trinidad, British West Indies, and Sugar Apple from Cardenas, Cuba; and *Anastrepha fraterculus* (Wied.) on Guavas from Havana, Cuba, arriving at Key West, Florida.

A committee composed of two representatives from the American Phytopathological Society, and one from each of the following organizations—the American Association of Nurserymen, the American Society of Horticultural Science, and the Section on Horticultural Inspection—is being appointed for the purpose of making a thorough study of Crown Gall in its various phases, and also to arrange a program for a joint session of the organizations mentioned above at the Cincinnati meetings. The full personnel of this committee has not been appointed; however, Mr. H. F. Dietz, Assistant Entomologist, of Indiana, has been designated to represent the Section on Horticultural Inspection.

The Public Hearing to consider the advisability of restricting or prohibiting the importation of fruits and vegetables in the raw or unmanufactured state from all foreign countries and localities on account of the Mediterranean and other fruit flies, held by the Federal Horticultural Board December 19, 1922, was well attended. The California State Department of Agriculture was represented by Mr. Lee A. Strong, and the State Plant Board of Florida by Dr. J. H. Montgomery. Both of these men took part in the discussion. Other out of town entomologists attending the hearing were Messrs. Glen W. Herrick (Cornell University), A. W. Morrill (California), and C. P. Lounsbury (Union of South Africa).

Notes on Medical Entomology

The New Jersey 1922 legislature appropriated $18,000.00 for mosquito control.

Mr. A. Robertson of the Treesbank laboratory, Canada, has now collected twenty-two species of mosquitoes in a special study he is making and many notes have been obtained of their breeding habits.

According to *Science*, Professor W. A. Riley, chief of the division of entomology, University of Minnesota, returned in September from a three month's stay in Porto Rico, where he made an intensive study of the relation of the soil conditions to the propagation of parasites.

On November 10 a mosquito conference was called at Houston by the Texas Chamber of Commerce for the purpose of formulating plans to reduce the economic waste and annoyance from mosquitoes in the Southwestern States. Considerably over one hundred health officers, sanitarians, drainage engineers etc., were in attendance. Following a brief address by Mr. J. S. Cullinan, President of the Texas Chamber of Commerce, the life history and habits of mosquitoes, especially Anopheles and *Aedes aegypti*, were discussed and demonstrated by Dr. A. C. Chandler of Rice Institute, in the absence of F. C. Bishopp who was unable to be present. Dr. J. A. LePrince of the United States Public Health Service discussed mosquito control and losses chargeable to these insects. Mr. V. M. Ehlers, chief sanitary engineer of the State Board of Health, discussed practical methods of controlling msoquitoes. Resolutions looking toward the formation of organizations in various parts of the Southwest to further mosquito control work were adopted. Dr. Oscar Dowling, State Health Officer of Louisiana, Dr. C. W. Garrison, State Health Officer of Arkansas, and Dr. J. H. Florence, State Health Officer of Texas, were in attendance and took part in the discussions. Dr. W. T. Davidson, Director of Public Health of Dallas, presided.

Notes on Apiculture

The Indiana State Beekeepers Association held a meeting at the State House, Indianapolis, December 21 and 22.

The seventh annual winter meeting of the North Carolina State Beekeepers Association was held at Charlotte, January 11.

The fall convention of the Connecticut Beekeepers Association was held at the State Capitol, Hartford, October 28.

The Northern Virginia Beekeepers' Association has just recently been organized. Clinton H. Shockey, Vienna, Va., is the Secretary.

The Wisconsin State Beekeepers' Association has planned to hold its annual convention at Milwaukee, December 14 and 15.

The University of Wisconsin announced a short course in beekeeping to be held at Madison, November 13 to December 20.

The annual meeting of the Northern Illinois and Southern Wisconsin Beekeepers' Associations was scheduled to be held at Freeport, Ill., October 17.

Dr. S. B. Fracker, State Entomologist of Wisconsin, has accepted the secretaryship of the American Honey Producer's League for the remainder of the year.

November 17 and 18 were the dates set for the meeting of the Oregon State Beekeepers' Association, Professor H. B. Scullen, Corvallis, Ore., Secretary.

The annual meeting of the Michigan Beekeepers Association was held at the Michigan Agricultural College, East Lansing, January 30 and 31.

The annual meeting of the Maryland Beekeepers Association was held at Frederick, January 10. Dr. E. F. Phillips and Professor E. N. Cory were among the speakers.

The annual meeting of the New Jersey Beekeepers Association was held at Trenton, January 18 and 19. Among the speakers were George H. Rea and Dr. E. F. Phillips.

The Empire State Federation of Beekeepers' Co-operative Association, Inc., will hold its annual meeting at Syracuse University, Syracuse, N. Y., December 5–7. O. W. Bedell, Earlville, N. Y., is Secretary.

The Iowa State Beekeepers' Association planned a mid-west beekeepers meeting at Council Bluffs, Iowa, on November 14 in conjunction with the mid-west Horticultural Exposition which ran through the week.

The annual meeting of the Chicago Northwestern Beekeepers' Association was set for December 4 and 5 at the Great Northern Hotel, Chicago, Ill. J. Frank Haan, Des Plaines, Ill., is Secretary-Treasurer.

According to *Gleanings in Bee Culture*, Mr. George H. Rea has resigned his position as extension specialist at State College, Pa., to accept a position with the A. I. Root Co., as service representative.

Messrs. Bruce Lineburg, A. D. Shaftesbury and B. Kurrelmeyer, who have been working temporarily in the bee culture laboratory of the Bureau of Entomology, have returned to continue their studies at Johns Hopkins University.

Purdue University, Lafayette, Ind., has announced a beekeepers short course and conference January 29—February 1. Dr. E. F. Phillips, George S. Demuth and Professor H. F. Wilson were expected to be present and make addresses.

The annual meeting of the Illinois State Beekeepers' Association was set for December 6 and 7, at the St. Nicholas Hotel, Springfield, Ill. Speakers expected were E. R. Root, C. P. Dadant, George E. King, and Allen Latham of Norwichtown, Conn.

The New York State College of Agriculture, Ithaca, N. Y., has announced a short course in beekeeping to be held February 20–23. Instructors will be Dr. E. F. Phillips and George S. Demuth, assisted by George H. Rea, E. W. Atkins and R. B. Willson.

Recent visitors at the Bee Culture Laboratory, Bureau of Entomology, were Dr. S. O. Mast, Johns Hopkins University; H. F. Wilson, University of Wisconsin; George H. Rea, Pennsyvlania State College; and Kenneth Hawkins, formerly an agent of the office, now with the G. B. Lewis Company, Watertown, Wis.

Mr. George W. York, Spokane, Washington, who for 20 years was editor of the *American Bee Journal*, has donated his entire collection of bee books and other beekeeping literature representing an accumulation of 40 years, to the University of California. The University in accepting this valuable gift has decided to establish the George W. York Library of Apiculture of California.

Pacific Slope Notes

Mr. G. A. Coleman, instructor in entomology at the University Farm, Davis, California, has resigned.

Mr. A. J. Flebut of the Bureau of Entomology attended the 55th annual convention of farmers and fruit growers at Sacramento, California, the middle of December.

The Entomological Field Station of the Idaho Agricultural Experiment Station has been moved from Twin Falls and Rexburg to Parma where experimental work will be conducted for a period of several years.

Mr. Harold E. Woodworth, Assistant Professor of Entomology at the University of the Philippines is visiting his home in Berkeley on a brief leave of absence. He has been in the Philippines for three years associated with Professor C. F. Baker at Los Banos.

Messrs. W. D. Whitcomb and E. J. Newcomer of the Bureau of Entomology were scheduled to attend the annual meeting of the Washington Horticulutral Association at Spokane, December 12–15. Mr. Newcomer was to discuss the control of the San Jose scale by the engine-oil emulsion.

Prof. C. W. Woodworth who is in charge of the entomological work in the Kiangsu Province with headquarters in the National Southeastern University at Nanking, sailed from Hong Kong on December 25 on a trip to Japan, India, Palestine and Europe, where he expects to spend some time at the entomological museums. He will return to China by New York and San Francisco, expecting to arrive in New York on April 14.

Dr. Edwin C. Van Dyke sailed for China on January 2, to spend his sabbatical year of 1923 in China and Japan. His headquarters will be the College of Agriculture, National Southeastern University, Nanking, China, and he will carry on some of the entomological work started by Professor C. W. Woodworth. Besides his instructional work, he hopes to make a general survey of entomological conditions in China, Corea and Japan insofar as his time will permit.

GIPSY MOTH AND EUROPEAN CORN BORER CONFERENCE

A conference at Albany November 16 to consider recent developments in the gipsy moth and European corn borer situations was called by Commissioner B. A. Pyrke of the Department of Farms and Markets of the State of New York, and invitations were sent to officials in all of the New England States, New Jersey, Pennsylvania, Ohio and New York, the U. S. Bureau of Entomology and the Dominion of Canada. Entomologists present were Doctors E. D. Ball, Director of Scientific Work, U. S. Department of Agriculture, L. O. Howard, C. L. Marlatt, Messrs. W. R. Walton, A. F. Burgess, D. J. Caffrey, L. H. Worthley and H. L. McIntyre of the U. S. Bureau of Entomology, Mr. L. S. McLaine and Dr. J. M. Swaine, Entomological Branch, Canadian Department of Agriculture, Dr. T. J. Headlee, State Entomologist, New Brunswick, N. J., Mr. W. A. Osgood, Assistant Entomologist, Durham, N. H., Dr. W. E. Britton, State Entomologist, New Haven, Conn., Professor P. J. Parrott, Entomologist, Agr. Expt. Sta., Geneva, N. Y., Professor G. W. Herrick, Entomologist Cornell Agr. Expt. Sta., Ithaca, N. Y., Dr. E. P. Felt, State Entomologist and Mr. D. B. Young, Assistant, Albany, N. Y., Dr. George G. Atwood, Director Bureau of Plant Industry, and Mr. B. D. Van Buren, Albany, N. Y. Dr. A. W. Gilbert, Commissioner of Agriculture, and Messrs. R. H. Allen, George A. Smith and C. O. Bailey, Boston, represented Massachusetts, Mr. Harold L. Bailey, Assistant Commissioner of Agriculture, Bradford, represented Vermont, and Mr. Sheals represented Rhode Island. Conservation Commissioner C. R. Pettis, and Agricultural Commissioner B. A. Pyrke were also present, the latter acting as Chairman.

The chief speakers on the gipsy moth were Dr. E. P. Felt and Mr. A. F. Burgess, followed by Messrs. Atwood, Smith, C. O. Bailey, H. L. Bailey, Osgood, Britton, Sheals, Headlee, McLaine, Pettis, Marlatt, Howard and Ball. Resolutions were formulated and duly adopted. The proceedings have been published by the New State Department of Farms and Markets as Bulletin 148.

In the afternoon the European corn borer was discussed, the principal speakers being Mr. W. R. Walton and D. J. Caffrey of the U. S. Bureau of Entomology, followed by Dr. A. W. Gilbert, L. S. McLaine, Drs. L. O. Howard, C. L. Marlatt and E. D. Ball. Resolutions were also adopted, asking that the present control measures be continued.

Dr. E. F. Phillips lectured before the Brooklyn Institute of Arts and Sciences on Janurary 13 on "Bees and Beekeeping."

The annual meeting of the Maryland State Beekeepers' Association was held in conjunction with the Farmers' Conference at Frederick, Maryland, on January 10. The principal speakers were E. F. Phillips of the Bureau of Entomology and A. D. Shaftesbury of Johns Hopkins University.

Contributions of books and journals for the Miller Memorial Beekeeping Library are being received from all parts of the world and the library already contains several very rare and valuable books. It is planned to dedicate the library some time during next August.

E. P. Felt will give a lecture on:—"Engineering and Insect Control," from the broadcasting Station of the Rensselaer Polytechnic Institute, Troy, New York, "WHAZ," wave length 360 meters between 8:15 and 9:30 P. M., Monday night, February 19th.

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Proceedings of the Thirty-Fifth Annual Meeting of the American Association of Economic Entomologists
(*Continued*)

SECTION OF APICULTURE

Thursday, December 28, 1922, 8.15 p. m.

The session convened in the Auditorium of the Boston Society of Natural History with Chairman M. C. Tanquary presiding.

Chairman M. C. Tanquary: I understand that a number of beekeepers belonging to the local associations are present to-night, and I want to express our appreciation of having them meet with us. They should all feel free to discuss any of the papers that are presented.

I will now appoint the following Nominations Committee: Dr. E. F. Phillips, Dr. W. E. Britton, and Professor G. A. Dean.

Secretary Bentley acted as chairman and the annual address was given by Chairman Tanquary.

RELATION OF THE TEXAS AGRICULTURAL EXPERIMENT STATION TO BEEKEEPING IN TEXAS

By M. C. Tanquary, *Chief, Division of Entomology, Agricultural Experiment Station; State Entomologist, College Station, Texas*

Abstract

The Texas Agricultural Experiment Station is conducting investigational work in bee keeping with head quarters in Bexar County, near San Antonio, Mr. H. B. Parks in charge. It is planned to make a thorough study of honey plants and of nectar secretion. There are two experimental yards in charge of well versed, practical bee keepers, one in southwest Texas and the other in north Texas and also small apiaries at each of seven different sub-stations.

The foul brood control work is vested in the chief of the Division of Entomology as State Entomologist with two inspectors attached to the office and ten local inspectors distributed in various parts of the State. A numerical summary of the work is given. Treatment for American foul brood is discouraged and destruction of the infected colonies urged.

The relation between the Texas Agricultural Experiment Station and beekeeping in Texas is two-fold. In the first place, the Experiment Station, through the Division of Entomology, is conducting investigational work in beekeeping, and in the second place the Chief of the Division of Entomology, as State Entomologist, is in charge of the foulbrood control work of the state. I will first discuss briefly the investigational work.

Investigational Work in Beekeeping

At the present time the headquarters for the investigational work in beekeeping is in Bexar County near San Antonio, to which place it was moved from College Station this past summer because of the exceedingly poor beekeeping possibilities in the vicinity of the latter place. A ten-acre plot of ground was purchased and an attractive and substantial brick laboratory building, containing an office, a laboratory, and a large store-room, was erected. In the near future it is planned to build a residence for the apiculturist. Mr. H. B. Parks, who is well-known to the beekeepers of the country through his work and writings, is in charge. Extensive planting will be made of all the honey-plants which grow well under the climatic and soil conditions obtaining in that part of the state in order to aid in a thorough study of honey-plants and of nectar secretion. The main apiary will be located here, and out-apiaries will be established in the surrounding country with the idea of making a study of all the problems of the commercial beekeeper.

About four miles from the headquarters laboratory is the experimental queen yard which is in charge of an expert queen breeder, Mr. A. H. Alex, a graduate of the Texas Agricultural and Mechanical College, who works under the direction of Mr. Parks. Here studies of the various problems of queen breeding are carried on. Queens are reared to supply the experimental apiaries in the state where they are tested for the various qualities that are considered desirable in queens. Each year the surplus queens are sold to the beekeepers of the state, selling not more than three to any one beekeeper, in order to obtain as wide distribution as possible and thus aid in bringing up the general level of quality of bees throughout the state, and especially in getting the average beekeeper to appreciate more fully the importance of good queens.

Two experimental yards have been established to study special problems in two of the most important honey producing regions of Texas, one at Dilley in southwest Texas, where mesquite (*Prosopis glandulosa*), huajilla (*Acacia berlandiera*) and catsclaw (*Acacia greggii*) are the

principal honey plants, and the other at Roxton in the black land cotton belt of north Texas. Both of these apiaries are in charge of well-versed practical beekeepers. The colonies comprising the two yards were donated by the beekeepers of those portions of the state in which they are located.

A new feature of the work this past year has been the establishment of a small apiary (5 colonies) at each of seven different substations of the Agricultural Experiment Station. Some very interesting results were obtained with these, especially where new territory was tested. At one of these stations in northwest Texas, so far as we could learn, there had never been a single colony of bees in the county, and everyone told us that bees would either be blown away by the high winds or at least starve to death. These 5 colonies were installed as 3-frame nuclei about the middle of May. By the middle of August, or exactly three months afterwards, one colony, in addition to drawing out 21 frames of foundation, had produced approximately 100 pounds surplus of as fine honey as I have ever seen. The other four colonies also had the 10-frame Langstroth brood-chambers filled with brood and honey and all the way from 15 or 20 to 45 or 50 pounds of honey in the supers.

In two other counties, one of which had previously contained but three colonies, and the other but two or three small beekeepers, the substation bees did almost as well for the season. This work will be continued this coming season and extended to other parts of the state.

Foulbrood Control

The second phase of the relationship between the Experiment Station and beekeeping in Texas comes through the foulbrood control work which is vested in the Chief of the Division of Entomology as State Entomologist. The plan for carrying on the work is as follows:

First, one or two inspectors are sent out from the office who put in practically all of their time in field work during the inspection season, which lasts from early in February to about the first of November. One of these men, Mr. C. S. Rude, has had general charge of the field work during the past three years. In addition there are ten local inspectors, located in various parts of the state, who take care of situations in their respective territories which cannot be handled promptly by the men sent out from the office.

We are very fortunate in Texas in that we have no European foulbrood, the American being the only form that we have had to deal with so far in a regulatory way.

A great deal of the work in the early part of the season is necessarily devoted to the inspection of the apiaries of queen breeders and shippers of package bees. This past season we granted 40 queen breeder's certificates, representing 14,098 colonies of bees. Most of these are located in parts of the state that are free from disease and would not require an annual inspection merely from the standpoint of foulbrood eradication. Therefore, this work, and the considerable amount of inspection which is required by people who want to move bees out of the state, or from one part of the state to another, decreases very greatly the amount of work which is directed specifically toward the eradication of American foulbrood.

The following is a general summary of the inspection work done in Texas during the fiscal year ending August 31st, 1922:

Number of colonies inspected	45,530
Number of cases of American foulbrood	618
Number of cases of American foulbrood destroyed	541
Number of cases of American foulbrood treated	77

Treating for American foulbrood is discouraged as much as possible and destruction urged in its place. We have become convinced that destruction is, in general, and in the long run, the cheapest and best method of dealing with this disease, and we have great hope that by following the present policy we will be able to entirely eradicate American foulbrood in Texas in the not very distant future. The beekeepers of the state as a body have endorsed our general policy looking toward foulbrood eradication, and it is because of their loyal support and cooperation that we hope ultimately to succeed in that effort.

Mr. S. B. Fracker: I would like to ask whether the number of cases given is the number of colonies or the number of apiaries?

Chairman M. C. Tanquary: It is the actual number of colonies.

Mr. L. Haseman: Have you had any opposition from the queen breeders, when you sent out, say, three queens to any one beekeeper?

Chairman M. C. Tanquary: Many of the people who have urged this particular work are queen breeders themselves. They are strongly back of that. I have heard of perhaps one or two who mentioned the possibility that we might interfere a little with their work as queen breeders, but when we have explained that our queen breeding is only ex-

perimental, and we limit out distribution to three queens to a beekeeper, they do not object.

Mr. Goldfarb: How much do you pay your inspectors?

Chairman M. C. Tanquary: The one who has general charge of the field work receives at the present time $2100 per year and expenses while in the field. He has been with us for several years now. The other we usually start in at $1200 per year, and if he stays with us over that period, increase it as we can. The one mentioned as having general charge of the field work does other work than that of an inspector during about two or three months of the year.

Chairman Tanquary resumed the chair.

Chairman M. C. Tanquary: The next paper on the program is

UTILIZATION OF VARIOUS CARBOHYDRATES AS FOOD FOR THE HONEY-BEE

By E. F. Phillips, *Washington, D. C.*

(Withdrawn for publication elsewhere)

Mr. R. N. Chapman: Do you know anything about the energy efficiency of a bee? How efficiently is it built up?

Mr. E. F. Phillips: You mean in muscular activity?

Mr. R. N. Chapman: How much of it goes to muscular activity, in reproduction, and so on?

Mr. E. F. Phillips: The only work which would answer that, is the work of Milner and Demuth, and their measured heat production agreed closely with the calories in the food consumed.

Mr. L. Haseman: I would like to ask whether diastases have been discovered in the alimentary canals of bees, as such.

Mr. E. F. Phillips: There are no examinations for any of the enzymes on the inside of the alimentary tract. They have all been made by taking the entire tract, the muscles and all adhering. There are no examinations of extracts from the juices which are contained inside the alimentary tract.

Chairman M. C. Tanquary: The next paper is by W. J. Nolan.

A TWO-YEAR BROOD CURVE FOR A SINGLE COLONY OF BEES

By W.J. Nolan, *Bureau of Entomology*

Abstract

The earlier work is briefly reviewed. Investigations were begun in 1920, weekly counts being made, but during 1921 and 1922 photographic records were taken, sea-

sonal records for fifty-three colonies being now available. In the vicinity of Washington brood rearing shows three major phases:—1. an abrupt rise from the beginning in March to the maximum peak in May, 2. a pronounced summer decline extending from the maximum until early August and 3. a late summer secondary peak and subsequent autumn decline. The first is of great importance and the peak should be reached three weeks before the honey flow. The second phase or summer decline is dependent in its rate upon the amount of incoming nectar or pollen. The third or final phase shows the amount of brood which can be cared for in early spring and is the one which may spell success or failure for the first phase of the next year. There is a direct relation between nectar flow and brood rearing. Prolonged inclement weather may retard brood rearing in the spring, though this may be overcome by strong colonies. A strong colony tends to remain strong.

The question of what actually takes place in brood-rearing throughout the active season is one concerning which very little of value has been published. It is true that there have been many conjectures and many attempts to estimate the number of eggs a queen is capable of laying in a single day, but all available records of periodic brood counts throughout an entire season may be counted on the fingers of one hand.

The earliest authentic count of the number of eggs laid by a queen in a single day was made in 1856 by von Berlepsch, the German investigator. He managed to confine the egg-laying activity of a certain queen to a single comb during twenty-four hours. A count then showed 3021 eggs. This number has since become classic, having been adopted widely as a proper index of a queen's daily egg-laying capacity. From this number von Berlepsch assumed that a queen might be capable of laying 1,300,000 eggs during her lifetime. Cheshire (p. 228) thought it a mere trifle to add 200,000 to this total, and he gives 1,500,000 as his estimate, adding that this is "a number so vast that the eggs, lying in contact end to end, would stretch about one and three-quarters miles." Many later attempts to ascertain the daily egg-laying rate have been made. Typical of these is that given by Doolittle in *Gleanings in Bee Culture* during 1918. Because he had estimated roughly that a certain colony possessed on one occasion sufficient brood to fill completely 18 to 20 Gallup frames, he concluded that the queen in this particular colony had been laying 5,000 eggs daily.

All such sporadic attempts to find out the daily egg-laying rate are highly interesting, of course, but after all they give little aid in any endeavor to determine what is going on in the way of brood-rearing throughout the season. This is all the more true because only too often the work has been done for an exceptional queen for a single day at the height of the season's activity. With this point in mind it is readily seen that no

accurate idea may be formed from such evidence as to what really takes place in brood-rearing throughout an entire season.

In America as early as 1859, Baldridge had conceived the idea of determining the egg-laying rate throughout the season by periodic counts. He actually made one such count of all the eggs, larvae, and sealed brood in each frame of a certain hive. The task was evidently too arduous, inasmuch as it was not continued further. Nevertheless the report of this single count as published in the first volume of the *American Bee Journal* (1861) forms the earliest available brood census.

It was nearly forty years later before anything of real value appeared on this problem. In 1895 Baldensperger published in *Gleanings in Bee Culture* some estimates made throughout the active season at intervals of from two to four weeks of the amount of brood in a given colony in Palestine. It must be admitted that, although these estimates are not absolutely accurate, they do furnish a fairly reliable index of what in general takes place throughout the year. This seems to be the first published work giving the results of periodic counts or estimates for such a length of time. Previously, as already stated, the results for a total season were mere calculations based simply on the results of a single count at the height of egg-laying activity.

The year 1901 marks an epoch in such investigations because at that time Dufour in the *Annuaire de la Fédération des Sociétés Françaises d'Apiculture* published the results of actual counts of brood made at intervals of twenty-one days from 1897 to 1900 inclusive, a period of four years. In the first three years he used two colonies, and in the fourth year only one colony. The magnitude of this work may be realized when it is borne in mind that Dufour actually counted each egg, larva, and sealed cell.

In 1919 Brünnich published in *Der Schweizerische Bienen-Zeitung* the brood curve of a single colony for the year 1918. His work, unlike Dufour's, is based, not on an actual count of each cell containing brood, but on a mathematical calculation of the number of such cells derived from linear measurements made throughout the season of the brood area on each frame, the number of cells in any chosen linear unit being well known.

Such in brief were the few outstanding attempts to throw light on the subject before 1920. In that year work was begun in this field at the Bee Culture Laboratory. For this purpose in 1920 five colonies, in 1921 sixteen colonies, and in 1922 thirty-two colonies were used. In 1920 weekly counts were actually made of all brood, both sealed and un-

sealed. During 1921 and 1922 a photographic method was employed whereby photographs were taken weekly of every frame containing sealed brood, and counts made later from the negatives, the sealed brood only being counted because of its greater clearness. As a result of the continuance of this work for three years, there are now available counts of brood made at weekly intervals during an entire active season for fifty-three colonies. The curves which form the basis of this paper are from one of these colonies for two consecutive seasons.

It is a matter of common apiary experience that the brood increases rather rapidly in the spring up to a maximum and then falls off during the remainder of the year. The rapidity with which the maximum is reached is especially striking in regions of early honey-flows with no later honey-flows of consequence. Furthermore, it is generally recognized that brood-rearing naturally reaches its maximum at or just after the height of the honey-flow. This is attested by the existence of such apiary practices as dequeening during a honey-flow, removing brood, and the like. Nevertheless, a clear definite understanding has not yet been reached of all of the factors causing increased brood-rearing activity or its decline. Nor has it been established whether the brood-rearing curve is regular and uniform in its rise to the maximum and in its subsequent decline, or whether breaks and irregularities may not occur both in the rise and decline. It is of interest then to glance at the seasonal brood curve of some individual colony.

The colony whose brood-rearing activity during 1921 and 1922 is described in this paper was located at the Bee Culture Laboratory at Somerset, Md. It was wintered unpacked in two, 10-frame Langstroth hive-bodies. During the course of the two years nothing whatever was done to stimulate brood-rearing. The queen, however, was allowed to roam at will through the hive. Although there was no restriction to any possible expansion of the brood area, on no occasion was brood found outside of the first three hive-bodies. The queen used throughout both seasons had been introduced into the colony in late summer in 1920 as soon as she had commenced to lay. In brief, each spring found this colony with a fairly strong force of bees, a prolific queen, combs composed chiefly of worker cells, and no shortage of stores.

To determine its seasonal brood-rearing activity, counts of all of the sealed brood in this colony throughout both seasons were made once each week. From these counts brood curves for each season have been constructed, these curves being so similar that they will be discussed as one. They show quite clearly that in the vicinity of Washington the

brood-rearing activity of the season may be divided into three major phases: (1) an abrupt rise from the beginning of brood-rearing in March

Fig. 2.—Brood curve for 1921 shown by broken line, that for 1922 by unbroken line. Vertical divisions represent months from March to October inclusive; horizontal divisions represent 5000 cells of sealed brood each.

until the maximum peak is reached at some time in May under normal conditions, (2) a pronounced summer decline extending from the maximum until early August, and (3) a late summer, secondary peak and subsequent autumn decline.

The first phase of the curve is all-important to the beekeeper during any current season, because a successful crop depends on the proportion

of the bees represented by the maximum peak which actually go to the field during the honey-flow. Under ideal conditions this peak would be reached three weeks before the honey-flow, and it is the constant endeavor of every alert beekeeper to have his colonies attain this peak at that time.

In the colony in question the maximum in 1922 was reached two weeks earlier than in 1921, although in the latter year a more auspicious beginning had been made. This was occasioned by the unusually early spring in 1921 during which nectar and pollen were coming in abundantly throughout March. During the two weeks following the 29th of March, however, there were six occasions on which the temperature reached the freezing point. Nightly during this same period the temperature dropped well below the clustering point. On four occasions the thermometer did not register over 57° F., for twenty-four hours, and on another occasion 62° F., was the highest temperature for forty-eight hours. Not only the effect of such weather on the nectar and pollen sources, but also the direct effect of the lower temperatures on the activity of the colony finally caused a break in the amount of sealed brood in the latter half of April. Although a recovery in the rate of brood-rearing was made subsequently, the peak was reached only after the chief source of nectar at Washington, the tulip-tree, was already in bloom. In 1922, on the other hand, there was a late spring, inclement weather in early March causing a temporary shortage of pollen in the hive. These conditions are clearly reflected in the curve for that month. Nevertheless, April weather more than compensated for a backward March, and by the end of the month nearly all flowers were as advanced as in the previous year. The result was a tremendous rise in the brood curve, causing the maximum to be reached two weeks in advance of that of the year previous. It was also in advance of the tulip-tree honey-flow for 1922, but just at a time when locust was in bloom. This caused brood-rearing to remain at its high level for about two weeks after the peak had been reached.

The second phase, or summer decline, is dependent in its rate upon the amount of incoming nectar or pollen. The decline during 1922 was gradual, there having been only a slight upward break in the middle of June due to an abundance of pollen. During the same month in 1921 there was a similar, upward break, but owing to two causes it was more pronounced. In the first place, as a result of the break during the rise to the maximum, the additional cells which would have been used for brood, had the brood area expanded continuously throughout the rise as

in 1922, had already been used for nectar and pollen coming in during the period between this break and the peak. When the maximum was reached, tulip-trees were yielding and many cells in the brood-nest proper were being used for nectar. Due to these circumstances the queen was partially restricted in egg-laying for several days, and in consequence the brood curve for 1921 drops from its maximum more sharply at first than is the case in the curve for 1922. Consumption or removal of the nectar in the brood area soon gave the queen more room, which she promptly used, thus making the curve at this point comparable again to that of 1922. The second cause of the more pronounced upward break of the curve during June, 1921, is due to the fact that associated with the incoming pollen of this month there was an exceptionally large amount of honeydew available, and also nectar from sweet clover in appreciable quantities. During both years the curves for the remainder of the summer decline follow courses almost parallel until the beginning of the final phase is reached in August. At the end of each season's second phase brood-rearing activity had been reduced to a point only one-third as great as that represented by the maximum for the same year.

The third, or final phase, is the one which may spell success or failure for the first phase of the succeeding year, because during it the young bees emerge which winter over and determine the amount of brood which can be cared for in early spring. In both 1921 and 1922 two minor peaks occurred during this final phase. The first of these represented a very intense pollen yield, and the second the fall nectar flow. After the latter peak there was a rapid decline until brood-rearing ceased completely. All in all, except for minor deviations due to differences in weather conditions, the curves of this colony during the two successive years present striking similarities.

In neither of these seasons did the queen approach any such rate as found by von Berlepsch in his experiment covering only twenty-four hours. For the colony to produce the total amount of sealed brood found in the hive during 1921, it was necessary for the queen to lay 202,830 eggs during the season, or an average of 905+ daily for 224 days. The total amount of sealed brood in 1922 represents 213,076 eggs, or an average of 895+ daily for 238 days. Although the total for 1922 is larger than for 1921, yet the average daily egg-laying rate is lower because the season in 1922 lasted 34 weeks instead of only 32 weeks as in 1921. The highest daily rate during any 12-day period in 1921 was 1488, while the highest daily rate during any similar period in

1922 was 1587. These figures may be compared with Dufour's maximum daily average of 1627 during one 21-day period. On the other hand his highest daily rate for any period of at least 32 weeks was only 791 eggs, as compared with the daily egg-laying rates of 905 and 895 for 1921 and 1922 respectively. Baldensperger in his rough estimates gives 930 eggs as a daily average over a period of 344 days. At the end of his article already referred to, Dufour makes a statement which applies with equal effect to the colony used in this research. Although he recognizes that the egg-laying rates which he publishes are only averages and, as such, were undoubtedly exceeded at times, yet he justly asserts that the results of his work do not warrant the assumption that any such daily egg-laying rate as 3000 or more had ever been reached in any of the colonies used in his experiments. Since the daily egg-laying average for any season is far below the daily egg-laying average for any particular number of days within that season, it is readily seen that the remarkably high rates of egg-laying over short periods, so often published in beekeeping literature, can not be used as the daily averages for an entire season.

The following general conclusions may be drawn from the curves presented here, assuming sufficient bees in the spring, a good queen, plenty of stores, good combs, and proper insulation.

(1) There is direct relation between nectar flows and brood-rearing activity. This also holds true for incoming pollen.

(2) Prolonged inclement weather may retard brood-rearing in the spring, although a strong colony may be able to maintain its rate through unfavorable, cold weather of only a few days duration, even though it is unpacked.

(3) Under such conditions as obtain naturally from year to year, a strong colony tends to retain its strength, as is evidenced by the remarkable similarity in brood curves found during two successive seasons in the same colony.

Chairman M. C. Tanquary: If there is no discussion, I will read the paper of J. H. Merrill.

VALUE OF WINTER PROTECTION FOR BEES[1]

By J. H. Merrill, *Apiarist, Kansas State Agricultural College and Experiment Station*

Abstract

Previous work is briefly summarized. The data secured during the past four years are tabulated and show that a wind break made an average difference of 8,600 bees in a one story, unpacked hive, 7,968 in a two story, unpacked hive and 3,539 in a packed hive, indicating that packing will to a certain extent offset the disadvantage of a wind break. A packed hive in a wind break shows a decided advantage over unpacked hives.

The behavior of the honey bee during the winter season has been carefully studied by Phillips and Demuth[2] and it is not intended to present in this paper any new facts concerning behavior of bees during the winter season, but rather to give some specific figures on the results which beekeepers may expect by applying the facts given by these authors.

Regardless of how clear an explanation may be of the necessity for following any line of procedure, if it involves work or expense, there will always be a large number of people who will claim that either the practice is not necessary for their locality, or else that it is too expensive.

An experiment has been carried on at the Kansas State Agricultural Experiment Station to secure data on the value of winter protection for bees. Phillips and Demuth have plainly shown that a colony of bees, in order to winter successfully, must have: First, a large number of young bees; second, plenty of good stores well placed; third, protection from prevailing winds, and fourth, sufficient packing with some insulating material. Why these are needed is carefully explained, and it was the purpose of the Kansas experiment to show definitely the value of applying these principles.

The results of the first three years' work have been reported[3] in which it was explained that two series of hives were used in the experiment, one set of which was protected by a dense windbreak of shrubbery, while the other was placed in the open. In each set there were used one

[1]Contribution No. 83, from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 126 of the Agricultural Experiment Station.

[2]Phillips, E. F., and Demuth, G. S.—Outdoor Wintering of Bees. U. S. D. A. Farm. Bul. 695, pp. 12, 1915.

Phillips, E. F., and Demuth, G. S.—The Preparation of Bees for Outdoor Wintering. U. S. D. A. Farm. Bul. 1012, pp. 20, 1918.

[3]Merrill, J. H.—Preliminary Notes on the Value of Winter Protection for Bees. Journ. Econ. Ento., Vol. 13, No. 1, 1920, pp. 99–111.

Merrill, J. H.—Further Notes on the Value of Winter Protection for Bees. Journ. Econ. Ento., Vol. 14, No. 1, 1921, pp. 111–114.

one-story hive and one two-story hive, all of which were left unpacked. In addition to these there were in each set a two-story hive placed in a packing box and insulated with four inches of packing beneath, six inches on the side, and eight inches on top. Each colony was requeened in August with a young queen and all of the queens used each year were from the same mother. In the two sets of hives—both the packed and unpacked—it was planned to leave sufficient stores to carry the colonies through until the honey flow began. In other words, it was attempted to have conditions in all of the colonies as nearly similar as possible in the fall of the year.

As a standard of what constituted good wintering, it was agreed that those colonies which possessed the greatest number of bees at the beginning of the honey flow were those which had wintered the best. In the fall of the year, and again in the spring, the number of bees in each hive was determined by a system of weighing in which a pound represented 5000 bees.

The results of the first two years' work with this experiment were published in the first paper. The results of the third years' work appeared in the second paper on this subject. As all of the results of this experiment have a similar trend, the data secured from the fourth years' work, which have not been published, will be averaged with the data secured from the first three years' observations.

Table 1 presents an average of the data secured in the four years during which this experiment was conducted.

Table No. 1.—Average Winter Gain or Loss For Four Years

Date	No Windbreak			Windbreak		
	No. 2 1-story Unpacked	No. 16 2-story Unpacked	No. 4 2-story Packed	No. 5 1-story Unpacked	No. 6 2-story Unpacked	No. 7 2-story Packed
1917 1918	-332	2,808	4,566	4,538	13,346	15,132
1918 1919	-3,282	469	22,968	313	5,936	24,844
1919 1920	625	-1,250	5,625	10,000	8,125	3,800
1920 1921	-25,358	-1,525	*	-8,800	4,029	47,575
Average gain or Loss	-7,087	-109	11,053	1,513	7,859	22,838

*Hive number four was blown over by the wind during the winter of 1920–1921, and was eliminated that year.

Where the result indicated is preceded by a minus sign, it signifies that there were fewer bees in the hive when it was weighed in the spring than in the fall. Where the result stated is a positive number, it indicates that there were more bees in that hive in the spring than in the fall. It will be noticed that during the winter of 1919–1920, neither

hive No. 16 nor hive No. 7 had as many bees as might have been expected.

Since it was the purpose of this experiment to ascertain the best methods of wintering, the failure of these two hives should be explained. The explanation is simple—they both lacked sufficient stores. On April 19th, the stores in colony No. 7 were practically exhausted. While this was indeed unfortunate for those individual colonies, it was fortunate for the experiment as a whole. Colony No. 7 had only an increase of 3,800 bees; whereas, had it had sufficient stores, the number might have been about ten times as many. The same condition applies to colony No. 16. Sufficient stores were left in all of these hives to amply supply their needs through an ordinary winter and spring. However, a severe freeze on Easter Sunday killed all of the fruit bloom; consequently, more honey was needed. An examination of the two colonies which were deficient in stores showed much less brood than any of the others, which would indicate that if the stores in a hive were nearing exhaustion, the daily rate of egg-laying would be materially lowered. This emphasizes the necessity for leaving plenty of stores.

The most marked results on the value of winter protection were those obtained during the winter of 1920–1921, which was very mild and open with frequent opportunities for the bees to take flight. In fact, it was very similar to winters in those parts of the country where the remark is often heard that "there is no need of packing our bees because we have such mild, open winters." Colony No. 7, which was not only packed but protected by a windbreak, had 47,575 more bees in the spring than it had in the fall, while the one-story unpacked hive in the open had 25,358 less bees in the same year, which would seem to answer the above quoted objection. A study of the results noted in Table II indicates that a windbreak is of much greater importance than is ordinarily believed.

TABLE II—VALUE OF WINDBREAKS

	No. 5 1-story unpacked	No. 6 2-story unpacked	No. 7 2-story packed
Protected by windbreak	1513	7859	*14,592
	No. 2	No. 16	No. 4
Unprotected by windbreak	7087	−109	*11,053
Advantage of windbreak in number of bees	8,600	7,968	3,539

*Colony No. 4 was blown over by the wind during the winter of 1920–1921 and was eliminated from the experiment for that year. It was during that year that colony No. 7 showed the greatest supreiority over unpacked hives; therefore, it seems reasonable to infer that colony No. 4 would likewise have shown a marked superiority, but as No. 4 was eliminated by accident, No. 7 should be eliminated during that year as well, hence, this table shows an average of three years' work instead of four.

The data recorded in this table show that the one-story hive in the windbreak had an average advantage over the one-story hive in the open of 8,600 bees. The two-story, protected hive had 7,968 more bees, while the packed hive in the windbreak, for a three-year average, had the advantage of 3,539 bees over the unprotected, packed hive. When it is not possible to have a windbreak, good packing will, to a certain extent, overcome this disadvantage. A dense mass of shrubbery protected the bees on the north, west, and south sides, while the east side was protected by a grove of trees. A study of Table III will show the marked advantage of packed over unpacked hives.

Table III.—Value of Packing

	Windbreak		No Windbreak	
	1-story	2-story	1-story	2-story
Packed	22,838	22,838	11,053	11,053
Unpacked	1,513	7,859	−7,087	−109
Four year average difference	21,325	14,979	18,140	11,162

The packed hive in the windbreak had an average of 21,325 more bees than the one-story hive, and 14,979 more than the two-story hive. In those hives unprotected by a windbreak, the difference in numbers is not quite so marked, yet there is a wide margin, as the packed hive had an average of 18,140 more bees than the one-story hive, and 11,162 more bees than the two-story hive.

Since there are about 5,000 bees to a pound, and as they are worth $2.00 a pound at present, it will be seen that beekeepers may incur considerable expense for packing and still be the gainers. Furthermore, the beekeepers will have the advantage of having these bees in their own hives at the right time of the year, which might not be the case if they were obliged to depend on strengthening their colonies with package bees.

Table IV.—Value of Sufficient Room in the Hive

	Windbreak	No Windbreak
2-story	7,859	−109
1-story	1,513	−7087
Four year Average Difference	6,346	6.978

When the one and two-story unpacked hives are compared, it will be seen that the two-story hive has an average advantage of 6,978 bees. When the similar hives, protected by a windbreak, are compared, the two-story hive will be found to have 6,343 more bees than the one-story hive. This difference is due to the fact that when the two-story hives are used it is possible to leave more stores, have them better arranged, and at the same time provide sufficient room for spring brood rearing. Judging from these facts, it would appear that if these conditions could

be met in a single hive body which would have the added advantage of having only one set of combs, the bees ought to winter better even than in the two-story hives. Some of the larger hives now in use should meet these requirements.

Summary

1. The purpose of this experiment was to show, by specific figures, the results obtained by applying the best known methods for wintering bees.

2. Six hives containing a known amount of honey and a known number of bees were placed on scales, and daily readings taken of all changes in weight.

3. Three of these hives were sheltered by a windbreak, while the others were not.

4. Each set of three consisted of one one-story hive, one two-story hive, and one packed hive.

5. In addition to making daily readings of the changes in weights, a general weighing was made at the beginning of the honey flow in the spring to determine the number of bees in the colonies on that date.

6. It was shown that a two-story hive, unprotected, averaged 6,346 more bees than a one-story hive similarly placed, and that in the windbreak the two-story hive averaged 6,978 more bees than the one-story hive.

7. It was shown that the windbreak made an average difference of 8,600 bees in a one-story, unpacked hive, 7,968 in a two-story, unpacked hive, and 3,539 in a packed hive.

8. It is indicated that if a windbreak is not available, added packing will, to a certain extent, offset this disadvantage.

9. It was shown that unless sufficient stores are left in the hive, the queen will not lay eggs to her fullest capacity.

10. It was shown that the packed hive in the windbreak has an average advantage of 21,325 more bees than the one-story, unpacked hive, and 14,979 more bees than the two-story, unpacked hive. Where there was no windbreak, the packed hive had an average advantage of 18,140 more bees than the one-story, unpacked hive, and 11,162 more bees than the two-story, unpacked hive.

MR. GREEN: Something was said in regard to the opportunity to fly during the winter. Provided they have an abundance of supplies and

a good queen, does not a great deal depend upon an opportunity for them to have a chance to fly through the winter?

Chairman M. C. Tanquary: I believe a great deal depends on the opportunity for flight. The figures were averages taken over a period of four years and in the latitute in which they were taken, there is very seldom a winter when there is more than two or three weeks without a chance for flight of the bees.

Mr. George A. Dean: Since the bees in both the packed and the unpacked hives in Dr. Merrill's experiment had the same opportunity for flight during the winter, the comparison as shown in the chart is a fair one. You will notice in the chart before you that there is a big difference between the packed and the unpacked hives.

Mr. Green: About three years ago we had an extreme shortage of bees here and the price increased greatly. The scarcity was due to extremely cold weather during the previous winter. The bees had no opportunityto fly although they had an abundance of stores. If they can fly twice during the winter, you can feel pretty sure of getting them through successfully.

Chairman M. C. Tanquary: The next paper is entitled "Rehabilitation Classes in Apiculture," by E. N. Cory.

REHABILITATION CLASSES IN APICULTURE

By E. N. Cory, *College Park, Md.*

Abstract

Bee keeping fits admirably in the scheme of rehabilitation of ex-soldiers, since it offers relatively large returns on the time and money invested and gives seasonal employment on clear days amid pleasant surroundings. A two term course in bee keeping is offered by the University of Maryland to beginning students of the Veterans Bureau supplemented by project work in connection with their placement training.

Vocational training in agriculture of ex-soldiers presents many problems. Not the least of these is the initial one of determining what fields of agricultural endeavor thei mental attitudes, finances and physical disabilities permit them to enter. Most soldiers who come to the eastern training centers are socially inclined, that is, they, and especially their families, want to be near or in cities, towns or villages. For the most part, they have come from such an environment, and they want to return there at the end of their training. Few evince the pioneer spirit that has been so manifest after our previous wars, when virgin lands were opened to settlement.

With such a mental attitude, rehabilitation courses should be along the agricultural lines, practicable near or in cities and villages.

The production of small fruits, vegetables, flowers, the raising of poultry and the keeping of bees, offer the best opportunities with this environment in view.

Finance plays an important part in the choice of vocation. The activities mentioned may be entered upon with less capital than the larger farm enterprises. Returns on the investment may be expected more quickly, which is certainly a desideratum.

Many in training are handicapped by physical disabilities, which preclude continuous exertion day after day for eight or ten hours per day. Others, through the loss of a hand, a foot or a leg can do only certain limited kinds of physical labor. To these must be added those who have mental troubles, which make for despondency, the magnification of bodily ills and the worry of small things gone awry.

Beekeeping fits admirably in the scheme of rehabilitation for men so handicapped, offering a relatively large return on time and money invested; giving seasonal employment, to be performed only on the clear or sunshiny days amid pleasant surroundings, and requiring study of its many problems that will engage the mind with a tendency to exclude the ex-soldier's mental troubles.

What to give the trainee to fit him to keep bees in a short time is, of course, debatable. It has seemed to the writer that however desirable a study of behavior is as a basis for the necessary operations of keeping bees, the operations or manipulations themselves should be stressed, at least in the first or beginning course.

With this in view, a two term course is offered to beginning students of the Veterans Bureau, supplemented by project work in connection with their placement training. The first term's work consists of one lecture and three hours in the laboratory per week. The lectures are illustrated by stereopticon, supplemented by exhibit material. Short quizzes are given on single, concrete questions as each natural division of the subject matter is finished. The laboratory work is designed to familiarize the student with his equipment, tools and apparatus.

One laboratory period is devoted to a study of the worker, drone and queen bee. Mimeographed outline drawings about eight inches long, of the three types of bees are given to the students, together with specimens, and the student required, by aid of text books, demonstrations, dissections and projected pictures, to place on the outline drawings, certain important structures and to label the parts of the bee.

Each student is furnished with a complete knocked down body, bottom board, cover, comb super, extracting super, sections, frames,

foundation and accessory parts. Under the guidance of a practical beekeeper as instructor, and with the aid of exact directions, the complete hive is set up, the supers outfitted ready for the bees and the equipment painted. Few beekeepers do this exactly right, and for the student to do it correctly requires some concentration. Each student now has a hive ready for the colony, which is either furnished as package bees or made up form a single frame nucleus during the spring term.

Wax extraction, liquefying and bottling honey, its grading according to color, body, clarity and nectar sources, and its sale, are each given ample attention.

The balance of the winter term is utilized in making up home-made devices, such a frame wiring apparatus, foundation fasteners, field tool boxes, etc.

The second term no lectures are scheduled, but informal lectures are given by the instructor during each laboratory period, which is spent in the bee yard, except when inclement weather prevents.

Stimulative feeding (its use and abuse), winter protection, in part, taught at time of unpacking, uniting, equalizing, swarm control, comb and extracted honey production, the simplest queen production and the establishment of nuclei, are the points stressed.

At the same time, familiarity with handling bees by actual manipulation by each student every laboratory period is insisted upon. Full protection by veils, leggings and gloves is required at first, but as confidence is acquired the student is allowed to dispense with the protection if he so desires.

Project work follows and consists of the establishment of at least one colony of bees on the farm where the trainee is getting his placement training. If he owns, or has a long lease, on the place where he is in training and seems adapted to beekeeping, he is encouraged to establish an apiary. Projects are visited at frequent intervals by the instructor, for the purpose of aiding the student in handling his bees, and to check up on his progress.

Wintering methods are worked out on the project, and those who wish to continue and seem to have the proper aptitude are given advanced class work, wherein the fundamental behavior problems and special topics are dealt with in detail.

Chairman M. C. Tanquary: We will pass to the next paper by S. B. Fracker.

PROTECTING AMERICAN BEES AGAINST THE INTRODUCTION OF THE ISLE OF WIGHT DISEASE

By S. B. Fracker, *Madison, Wis.*, C. B. Gooderham, *Ottawa, Canada*, and Geo. H. Rea, *Reynoldsville, Pa.*

Abstract

Legislation to prevent the introduction of the "Isle of Wight" disease in America has been enacted during the summer in both the United States and Canada, following a series of conferences and suitable publicity, the bill being finally drawn so as to regulate the importation of all honey bees. The bill is reprinted in the paper.

Legislation to prevent the introduction of the Acarine or "Isle of Wight" disease into America has been enacted during the past summer in both the United States and Canada. The leading part in the adoption of this legislation was taken by the section on apiculture of this association in cooperation with the Bureau of Entomology, United States Department of Agriculture.

Since its discovery in 1904 on the Isle of Wight, this disease spread with comparative rapidity and recently had become the most feared of all known maladies of the honey bee. Its ravages at the place of discovery were soon duplicated in other parts of the British Isles and before 1920, the rate of mortality of infected colonies was believed to be one hundred per cent. Alarm at the manner in which the infection was spreading and the rate at which diseased apiaries were being wiped out resulted in extensive investigations to determine the cause.

On November 1, 1920, Dr. John Rennie of Aberdeen, Scotland, announced the discovery of a mite parasitic in the respiratory tract of infected bees, which proved to be constantly associated with this disease. The mite was described as a new species and given the name *Tarsonemus woodi*, later being placed by Hirst in a new genus, *Acarapis*.

Previous belief that the "Isle of Wight" disease was caused by a protozoon, *Nosema apis*, of world-wide distribution, and that its virulence was due to some environmental condition in the British Isles had lulled American Beekeepers to a sense of security. Dr. Rennie's discovery changed the situation and investigations were carried on during 1921 by the Bureau of Entomology to determine, first, whether the mites were present in the United States, and second, whether they could be imported in commercial shipments of queen bees and their attendants. As a result the mite has thus far not been found on the American continent, but, in the case of an experimental shipment of bees from Scotland, they survived a transatlantic trip, showing conclusively that their introduction in this way is possible.

The presentation of these facts to the apicultural section of the Ameri-

can Association of Economic Entomologists at the Toronto meeting in December, 1921, caused the adoption of a resolution favoring legislation to protect American bees from this parasite. The authors of the present paper were appointed as a committee to sponsor such legislation in the United States and Canada, and cooperated with Dr. E. F. Phillips of the federal department of agriculture to this end.

As a result of a conference called at Washington, D. C., on March 9, 1922 an additional committee on publicity was appointed, consisting of J. G. Sanders, president of this association, E. G. Carr, New Brunswick, N. J., and F. Eric Millen, Guelph, Ontario, whose newspaper and journal articles were largely responsible for the public support given the bill at its committee hearings and on the floor of the House and Senate.

The first step in the direction of a general quarantine consisted of a postal order, issued by Acting Second Assistant Postmaster General E. R. White, on March 21, 1922, prohibiting "the importation of honey-bees through the regular and parcel post mails," with the proviso that "this prohibition does not apply to bees imported from Canada." The order was issued promptly upon presentation of evidence showing its desirability, and appropriate notice given to European countries through the International Bureau at Berne. It came in time to protect the United States for the season of 1922.

Shortly thereafter, the Deputy Minister of Agriculture of Canada issued an order under the Dominion Animal Contagious Diseases Act specifying that "On and after the first day of May, 1922, the importation into Canada of bees, used or second hand hives, or raw hive goods or products, excepting honey or wax, from the Continent of Europe, is hereby prohibited owing to the danger of introducing a contagious disease of bees known as 'Isle of Wight' disease" A supplementary letter from the Minister stated that this order covered Great Britain and Ireland which are considered European countries.

Bills providing similar legislation for the United States were introduced into the Senate by Senator Norris and into the House of Representatives by Congressman Haugen on April 22, 1922. At the House committee hearing this association was represented by Prof. E. N. Corey and Dr. Phillips, and at the Senate hearing by Dr. Phillips.

The bill (H. R. 11396) passed the House of Representatives on June 5, and the Senate on August 23, and was approved by the President on August 31, 1922, going into effect at once.

In the meantime the mite causing the disease was found in several additional European countries, making it clear that the federal regula-

tions must cover a wider territory than the British Isles. Dr. Ellinger of Weimar is authority for the report that it has been discovered in Germany; Professors Bouvier, Leclainche, Vallee, Berland and Mamelle of Paris have shown its presence in different parts of France; and according to the *Schweizerische Bienenzeitung* it also occurs in Switzerland. The exact extent of the area to which the prohibition will apply is to be determined by the Secretary of Agriculture. as will be seen from the provisions of the bill.

In connection with the committee hearings a certain amount of opposition developed by correspondence, all of it based on the assumption that the quarantined area would include the countries from which Caucasian and Carniolan bees are imported. The bee journals, however, gave generous space to the proposed legislation, the American Honey Producers League arranged for the appointment of a committee to cooperate with the members of this association, and prominent beekeepers and inspectors wrote their congressmen favoring the bill. The assistance of George S. Demuth and E. R. Root, was especially valuable as they appeared in person before the House and Senate committees respectively.

The United States has suffered so extensively from European, Asiatic, and African pests and diseases of plants and animals that the present move is a most encouraging one. The Acarine disease, if introduced, would perhaps not wipe out honey production completely, but it would unquestionably add new and serious difficulties to profitable beekeeping, materially increase the cost of production, and make the occupation more hazardous than it is at present. One of the members of the House committee, while apparently forgetting the battle raging over horticultural "quarantine 37," nevertheless expressed his approval of the principle involved by commending the bill and adding: "This is the first time in my experience that a scientific department of the government has advocated the stopping and stamping out of disease before we had to spend a lot of money in hunting it up in this country."

The act as passed, which may be obtained as document 293 of the 67th congress, is as follows:

A BILL to regulate foreign commerce in the importation into the United States of the adult honeybee (Apis mellifica).

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That, in order to prevent the introduction and spread of disease dangerous to the adult honeybee, the importation into the United States of the honeybee (Apis mellifica) in its adult stage is hereby prohibited, and all adult honeybees offered for import into the United States shall be destroyed if not immediately

exported: *Provided,* That such adult honeybees may be imported into the United States for experimental or scientific purposes by the United States Department of Agriculture: *And provided further,* That such adult honeybees may be imported into the United States from countries in which the Secretary of Agriculture shall determine that no diseases dangerous to adult honeybees exist, under rules and regulations prescribed by the Secretary of the Treasury and the Secretary of Agriculture.

Sec. 2. That any person who shall violate any of the provisions of this act shall be deemed guilty of a misdeameanor and shall, upon conviction thereof, be punished by a fine not exceeding $500 or by imprisonment not exceeding one year, or both such fine and imprisonment, in the discretion of the court.

Chairman M. C. Tanquary: The next paper is by E. F. Phillips.

ISLE-OF-WIGHT DISEASE, WITH SPECIAL REFERENCE TO GEOGRAPHICAL DISTRIBUTION

By E. F. Phillips, *Washington, D. C.*

(Withdrawn for publication elsewhere)

Chairman M. C. Tanquary: These two papers are now open for discussion.

Miss Morse: Would the bee die before you knew what was the matter with it, if it had these mites in it?

Mr. E. F. Phillips: It is difficult to answer that question because the symptoms of arsenical poisoning, bee paralysis and other diseases to which the bee is heir, are identical. With the Isle-of-Wight disease there is more of a tendency for the bee to crawl than with the others. We are anxious to have suspicious bees sent to the Bureau of Entomology for observation. In 1921 and 1922 beekeepers sent bees to us from all over the country, and in all cases they were found to be free of the mites. So the hope is getting stronger every day that we do not have it.

After the approval of this law, about which you all know, on August 31, it became necessary to give attention to what countries should be exempted from the operation of the law under its provisions, and what method should be used for permitting importation of bees. I have drawn up some material here which is not intended for publication, but it is some proposed regulations, which would not interfere unduly with beekeeping but would provide all the safeguards intended by the law. I will read these and I want you to understand that we should be de-

lighted to have suggestions of any kind sent in. Just as soon as we can arrange it, we will have a hearing on these regulations so that everyone will have an opportunity to say what he feels.

Perhaps it is not quite the thing for me to make this recommendation, but the committee which was appointed last year did such good work that it seems to me that it might be desirable and advantageous for this Section to appoint a committee to continue with this work until such time as satisfactory regulations have been adopted.

I was about to say that the same committee should be continued. The only objection to that is that Mr. Gooderham from Canada is a member of the committee, and he is naturally not concerned with the regulations within the United States. I have no objection, of course, to Mr. Gooderham personally, but he would hardly be a man to continue on the committee. With that one change, I think it would be fine to have the same committee continued.

Chairman M. C. Tanquary: What is your pleasure regarding this matter? It seems to me it would be well to have the same committee continued with the addition of one man in place of the one member from Canada who consequently should not be on the committee. It might be well to leave the selection of that one man to the present members of the committee. They might choose someone to work with them, unless someone wishes to move otherwise.

Voted that the committee select another member to replace Dr. Gooderham and continue its work throughout the year. The committee subsequently selected Prof. E. N. Cory of Maryland.

Mr. L. Haseman: I would like to ask to what extent at present do we get Carniolan bees?

Mr. E. F. Phillips: There has been a small trade in Carniolan bees but of course during the war it was impossible to get the Carniolan stock as long as they were on the other side of the battle front. After the war there were, I should say, several dozen queens brought in. I do not assume that it is the function of the Federal Department of Agriculture under this law to regulate what sort of bees the beekeepers of the country should use.

It seems to me the regulations should be made with regard to the safety of the importations rather than their prospective size.

If we could get information from Carniola, which so far has been impossible, it would be different; but we do not know whether they have disease or not.

Mr. L. Haseman: It seems to me that for several years we have had no way of finding out anything of those countries.

Mr. E. F. Phillips: The situation is not favorable for taking up the necessary investigations in any of those countries.

Secretary G. M. Bentley presented a resolution stating that on account of the amount of apicultural matter that was being published in the Journal of Economic Entomology, that the Section bring to the attention of the general association the desirability of having one member of the Section on the Advisory Board of the Journal. He stated that this resolution was offered not as a criticism of the present management but with the desire to make the Section of Apiculture as effective as possible.

The resolution was adopted.

The Committee on Nominations recommended the following officers for the ensuing year: Chairman, S. B. Fracker; Secretary, G. M. Bentley.

The report was accepted and the members named elected.

Adjournment, 10.30 p. m.

SECTION OF HORTICULTURAL INSPECTION

Friday, December 29, 1922

The meeting of the Section of Horticultural Inspection convened at 9.45 a.m.

In the absence of Chairman R. W. Harned, Mr. E. N. Cory was called upon to preside.

Chairman E. N. Cory: We greatly regret the absence of Professor Harned, but since he is not present, I will appoint the following nominating committee: Mr. W. E. Britton and Mr. A. G. Ruggles.

The first paper will be by Mr. C. L. Marlatt.

WORK OF THE FEDERAL HORTICULTURAL BOARD

By C. L. Marlatt

(Abstract)

It was pointed out that the publications of the Board made available a full record of its various activities, namely, the Service and Regulatory Announcements issued at irregular intervals, the Annual Report, and the various quarantines, notices of hearings, and explanatory circulars.

Discussing the growth of the work, it was stated that this work now involves the services of 150 technical men and some 75 State collaborators, and appropriations which will total for the current fiscal year $820,430. It was noted also that the Board is concerned in the enforcement of various quarantines and regulations thereunder on appropriations made to the Bureaus of Plant Industry and Entomology, which, together with the appropriations made directly to the Board, make a total of upwards of $2,000,000 expended in plant regulatory and special pest control work. The present status of the important subjects of such control was given.

The importance of the port and border control work was explained at some length, the character of the organization—State and Federal—and the effort which was being made to strengthen and increase this service which now involves a Federal expenditure of some $200,000, including the Mexican border work, and a State expenditure of perhaps $100,000.

A brief general discussion was given of the 22 foreign and 15 domestic quarantines being enforced under the plant quarantine act and of the present status of Quarantine 37, and particularly of the very much improved public reaction toward this quarantine involving its hearty endorsement now by practically all of the State, National, and regional associations related to plant production.

A brief discussion was also given of the proposed restrictions which are being considered in relation to foreign fruit and vegetable imports to prevent the entry into the United States of the many important fruit and vegetable flies which are prevalent in most foreign countries and which so far, fortunately, the United States is free from.

Mr. T. J. Headlee: May I add a word on the Japanese beetle situation. From the time of its first discovery in 1916, to and including 1921, the economic damage done by this insect was so slight as to fail to convince perhaps the majority of the people, living in the most heavily infested portion of the district, that the insect was sufficiently injurious to merit an attempt to bring it under control. In 1922 the economic damage was sufficient to cause almost a complete reversal in sentiment. It is significant, however, that even in 1922 orchards thoroughly sprayed were not in any case seriously injured.

The ability of the Japanese beetle to do serious harm depends upon its abundance, and even when it becomes sufficiently abundant to do harm, crops may be protected by thorough spraying. It does not seem likely that further increases in numbers will reduce the

effectiveness of spray because, if the beetles feed upon the foliage, which has been sprayed with four pounds of powdered arsenate of lead to fifty gallons of water, 60 % to 70% die.

Furthermore, the data indicate that natural enemies are already beginning to make a reduction in numbers. It is true that this reduction, which is only about 2% does not, in any way equal the percentage of increase, but it may be taken, I think, as a straw indicating the way in which the wind is beginning to blow.

Crops that are constantly cultivated throughout the beetle season, do not show during the fall or the following spring any considerable number of grubs in the soil. Plowing or disking the soil to a minimum depth of four inches just after the frost makes its first appearance in the ground seems practically to clean up Japanese beetle grubs.

Natural enemies from Japan are being introduced into the infested district. It is planned to examine Korea, Northern China and Northern India for additional, probably effective species.

A quarantine designed to prevent the insect from being distributed on the "long jump" is being vigorously and apparently effectively enforced. This quarantine has both state and inter-state features and it is enforced by the laboratory organization, working under the immediate direction of Mr. C. W. Stockwell, who has charge of the quarantine division of the Japanese Beetle Laboratory. To show you the severity with which this quarantine is being administered I have only to point out that a nursery of considerable size, located within the infested district and devoting the majority of its energy to the production of evergreen shrubs and trees is completely unable to do business in plants of this kind outside the quarantine area. The enforcement of this quarantine offers hard conditions to a nursery of this sort but the safety of the rest of the country at large demands that this procedure be carried out, until some practical method of cleaning the earth ball has been discovered. As the normal spread of the insect goes on, more nurseries of this sort will be found to be included within the infested district, and the interference with the normal business carried on by those concerns will be very large and the losses entailed will, I believe, be very considerable.

Appropriations for the adequate carrying out of this work against the Japanese beetle have in the past been forthcoming and larger ones seem in immediate prospect, not only from the United States government but from the states of New Jersey and Pennsylvania.

CHAIRMAN E. N. CORY: We will now listen to a paper by Mr. Leonard Haseman.

INSPECTING NURSERY STOCK AT DIGGING TIME

By LEONARD HASEMAN, *Columbia, Mo.*

ASTRACT

Great opportunities are offered in inspection work. Summer inspections are inadequate and inspections at digging time with a uniform system of certification, probably regional, is suggested.

The writer's fifteen years experience with Plant Inspection work in Missouri has convinced him that no other line of work offers greater opportunities for real service to Agriculture and Horticulture. Yet many states have been slow to recognize the importance of the work and to adequately provide for its proper enforcement. Even the United States Department of Agriculture did not get effective legislation passed until long after a number of serious foreign plant diseases and insect enemies of agriculture had been introduced. With the arrival of the San Jose Scale in the United States many of the states became active in passing hurried legislation which in most cases was later replaced with broader and more carefully drawn legislation. Missouri comes in this group.

The present Plant Inspection Service was created by the Legislature in 1913. It was 1919, however, before any funds were appropriated for carrying out the work. Previous to that the Agricultural Experiment Station furnished the inspectors and the field expenses were paid by the growers receiving inspection. In 1921 the biennal appropriation was increased to $10,000 and the next one will undoubtedly be further increased. Still the funds are far inadequate to make it possible to organize the work on a basis to properly meet the needs of the state.

INSPECTION WORK

Under our present organization the annual inspection of nurseries, floral establishments, berry fields and sweet potato slip beds has always been carefully done. However, in the past few years we have had definite proof of the fact that summer inspection is not sufficient. It is all right so far as it goes but where scale, crown gall and the like appear, the nurseryman needs further help later and the inspection service is under obligation to give it. The culling out of infested or diseased trees or plants is the duty of the inspectors and should not be placed as an obligation on the nurseryman. In the

past we have been obliged to extract from the nurseryman in the form of a sworn statement, a promise to make our certificate mean what it says when placed on a shipment. That other states have been obliged to do the same in the past is evident from the fact that each year some scale infested stock is shipped and delivered to fruit growers with state inspection certificates attached. All inspectors of experience know that this is true and yet it can hardly be avoided unless the summer inspection is followed by actual inspection of every tree in the fall or spring at digging time.

Inspection at Digging Time

That we must come to the regular practice of inspecting and culling all nursery stock at digging time is the opinion of many inspectors and nurserymen alike. That it will be expensive and difficult to administer is perfectly apparent. Yet if conscientiously carried out it will revolutionize plant inspection work. Uniform inspection laws administered under varying degrees of laxness can not possibly accomplish much toward actual uniformity of results as desired. However, if a competent inspector looks at every tree as it comes from the ground from every nursery in the United States and destroys every tree that fails to pass inspection, then and only then can we really say that we are rendering the service nurserymen, fruit growers and farmers have a just right to expect of us. Then and only then can we honestly place our stamp of approval in the form of a certificate on shipments of nursery stock.

This year the Missouri Plant Inspection Service has added to its regular annual summer inspection work the inspection of stock at digging time. All the small nurseries found infested with scale or dangerously near infested orchards and one of the largest nurseries in the state, at the request of the owners received this added service. About three hundred acres received inspection at digging time this fall. With the co-operation of the nurserymen the work can be carried along rapidly. The most conspicuous troubles with trees are readily apparent to any experienced foreman and can be discarded by him in the field when lifted from the ground. In this way one man can in a few days inspect and cull all the stock grown by a small nurseryman and two or three men can handle the stock as fast as the larger firms can bring it in from the field, especially if the haul is fairly long. For a state like Missouri with one hundred nurseries scattered over an area roughly three hundred miles square this will

necessitate the use of a considerable force for one or two months. But suppose it does it will be far cheaper than to have a veritable army of inspectors, as some states maintain, to run down and inspect each small order or bundle of trees at points of destination. It will be cheaper to the states as a whole, far cheaper and more satisfactory to the nurserymen and better protection to the buying public.

Intense Culling

It may be of interest to many of the st ate and federalinspectors to hear that associated with this program in Missouri, a number of our larger growers have entered upon a program of culling severely and let the public pay the price for clean, number one stock. Firms that have been discarding faulty trees, due to crown gall, aphis, hairy root and like troubles to the extent of 25% are now considering a cull up to 50% if need be. One firm receiving inspection at digging time is culling in the field to the extent of 60% of all trees of certain varieties. In this case the inspector has been throwing out on an average only one or two trees in a thousand after they reach the packing sheds. This is indeed culling with a vengeance for this particular nursery is on ideal soil remote from orchards and they have always grown exceptional stock.

In one of the smaller nurseries receiving inspection at digging time and where scale has gotten in, the inspector has been throwing out for all troubles about $1,000 worth of trees a day. The most encouraging part of the work is the fact that the nurserymen are calling for this help with culling and are giving every assistance with their field and packing house crews.

A Suggestion

Without going further into details about the present work in Missouri the writer wishes to say again that it appears to him as tho this is the only real solution of the inspection of nursery stock in the future. It is the only fair and just way of inspecting and certifying stock. It will stop trouble before it leaves the nursery and if all state and federal forces will co-operate it will prove also the most economical plan.

At this point I wish to offer one suggestion for your thoughtful consideration. We have long discussed the importance of uniform inspection and all agree that if possible to attain it, it would be a great thing. Here we have an opportunity to really enter upon a

plan that will come as near giving what we desire as we can ever hope for. In the past we have fallen short of our aim due to variation in requirements and methods and to the influence of geographical location on the dangerous insects and plant diseases of nursery stock. By inspecting at digging time the first two factors can be largely eliminated and a committee selected geographically could largely iron out the third difficulty. Funds and men are the outstanding difficulties we have encountered and a further suggestion here will bear on that point.

In the first place why should Mississippi, for instance, be forced to maintain a staff of inspectors to inspect at point of delivery all small or large shipments of stock from Missouri and other states. Would it not be cheaper and more satisfactory for Missouri to spend say one half that amount on inspection at digging time when all these small orders are assembled at one or a few packing houses perhaps. The inspection and movement of nursery stock is no longer a state matter but one of inter-state and national importance. The various states and the Federal Departments should closely co-operate in carrying it out effectively. Why could there not be a regular staff of state and federal inspectors, with uniform training, grading uniformly, working from the north toward the south as the fall advances. A combined state-federal certificate or a straight Federal Horticultural Board Certificate could be issued. In fact following out the purpose of federal quarantine regulations a grower might be given a certificate which would enable him to ship stock only to certain areas should any insect pest or disease appear which might be important only in certain parts of the country. We have already the beginning of such federal aid and co-operation; is it not feasible to extend it to include all interstate control of nursery insects and diseases which is really the present purpose of our nursery inspection work. I offer these suggestions for the thoughtful consideration of the State and Federal inspectors present and later during the business sessions if the matter is considered worthy of more serious consideration a committee, of which Dr. Marlatt should be a member and preferably, chairman, might be appointed to look into the possibility of such a basis of future co-operation and betterment of our nursery inspection work throughout the country. If the plan is workable and will render greater uniformity and cleaner, better stock then we can certainly count on the co-operation of the nurserymen of the country.

Mr. L. S. McLaine: I was glad to hear Mr. Haseman's discussion on the inspection of nursery stock at the time of packing. Up to the present time I know there has been great concern in inspecting imported shipments from other countries or other states, but when it comes to the inspection of outgoing shipments from particular areas, there is not as much care given, and blanket certificates have been issued with only a single summer inspection.

In Canada we are contemplating a modification of our regulations dealing with the importation of nursery stock from the United States and one clause that is receiving very serious consideration is one which will require the inspection at time of packing of shipments from the United States and consigned to various Canadian points.

I regret to say that in numerous shipments from various states, inspection showed that these were not as free from pests as one would like. I think the time will come— and I hope it will not be far off— when nurserymen will be impressed with the idea that it is necessary to ship only clean plants, and that no certificates should be given uness the plants are clean and free from all pests and diseases.

Secretary A. F. Burgess: In connection with the gipsy moth work, we have always followed the plan of making inspections at the time of shipment. This includes an examination of lumber, stone, and quarry products as well as of nursery stock that is going outside of the quarantined area. Inspection at the time of digging and shipment of nursery stock is undoubtedly the best way of preventing the spread of injurious pests; nevertheless, in the enforcement of such inspections there is serious difficulty in securing efficient men for the short rush season that covers the shipping period in spring and fall. It requires a large number of men who should be well trained and efficient and the time for active work is limited. If some plan could be devised whereby a number of men of this type could be provided with other work to carry them through the rest of the season, I believe that inspection at the time of shipment would be entirely feasible, if you wish to get results and do not believe you can depend on local inspectors hired temporarily; for if the work is important enough to do, it should be done well; otherwise, you miss the protection that you desire to secure.

Mr. L. S. McLaine: Possibly some of you know that the State of Idaho contemplates the establishment of a series of inspection stations through which all shipments must enter and be examined.

Secretary A. F. Burgess: While I have not been in very close

touch with nursery inspection for some time, I do know in a general way that the complexities of inspection from the nurserymen's point of view are continually increasing. Years ago the nurserymen were not willing to support a plan designed to bring about more uniformity. Possibly at the present time sentiment has changed in this respect. It seems to me that a method such as that outlined by Mr. Haseman should be considered thoroughly and that it might result in a more simple system than is in operation at present.

Chairman E. N. Cory: We will now listen to Mr. Rockwell who represents the Nurserymen's Association.

BUGS, BUGOLOGISTS, BUGABOOS AND NURSERYMEN

By F. F. Rockwell, *Bridgeton, N. J.*

(Paper not submitted for publication).

Chairman E. N. Cory: The next paper is by Mr. R. Kent Beattie.

IMPORTANT PLANT DISEASES COLLECTED ON IMPORTED NURSERY STOCK IN 1921 AND 1922

By R. Kent Beattie, *Pathologist in charge Foreign Plant Quarantines, Federal Horticultural Board*

Abstract

Quarantine 37 seeks to reduce the risk of importing foreign plant diseases and insect pests by limiting the entry of plants to those necessary and by surrounding such entry as is permitted with the safeguards of (1) Freedom from soil, (2) Importation in safest form, (3) Inspection on entry, (4) Disinfection, (5) Field inspection, (6) Port inspection of baggage and freight. A list of important plant diseases intercepted during the years 1921 and 1922 is appended.

The establishment of Quarantine 37 in 1919 and the subsequent development in the methods of its enforcement have increased the safeguards thrown around the importation of nursery stock and have somewhat modified the system of inspection previously used. This quarantine has now been in operation for three and a half years and it would seem opportune that the system of safeguards and inspection should be summarized.

The Horticultural Inspectors of the country are fully aware of the fact that every plant imported carries with it the risk of bringing some plant disease or insect pest. The quarantine seeks to reduce this risk to a minimun both by limiting importation and by safeguarding material the importation of which is necessary.

The first great safeguard is the rule that plants must be freed from sand, soil, and earth. The necessity for this rule was largely established by years of observation and inspection on the part of State and Federal inspectors and need not be further discussed here.

The second safeguard is the limitation of imported plants to the safest form in which material which will meet the needs can be imported. The leniency, for example, which the quarantine exhibits toward the introduction of seeds of trees and shrubs is due to the belief that wherever the material involved will come true from seed it is safer to introduce it in that form. Root, stem and leaf diseases and insect pests are thereby largely eliminated and the seeds will usually withstand more easily necessary disinfection.

The third safeguard is inspection on entry. The inspection system varies in regard to different types of plants and may be classed as follows:

(1) Bulbs permitted unlimited entry, included in Regulation 3, Item (1), namely:

Lilium, Convallaria, Tulipa, Hyacinthus, Crocus, and Narcissus and beginning with January, 1, 1923, Chionodoxa, Galanthus, Scilla, Fritillaria meleagris, Fritillaria imperialis, Muscari, Ixia, and Eranthis which together with Narcissus will then be permitted unlimited entry for a period of not exceeding three years.

If these bulbs first arrive in the United States at one of the ports where the Federal Horticultural Board maintains a port inspection service they are met at that port, the inspection is completed, and the necessary notices are there required; if their first arrival is at a port other than the above, notices are filed with the Collector of Customs and the State Inspector of the state of destination is notified of their arrival and their inspection is in his hands.

(2) Fruit stocks, cuttings, scions and buds of fruits, and rose stocks and seeds covered by regulation 3, Items (2), (3), (4), and (5) are superficially examined at the port of first arrival for compliance with the requirements as to certificate and markings, the proper notices are required and the plants are forwarded to destination for inspection by the State Inspector.

(3) If the importer desires to import seeds by mail a special mail permit is issued to him and special mail tags are furnished him which direct the shipment to Washington, D. C., or San Francisco, California, as may be most convenient and the material receives direct Federal inspection.

(4) Plants imported for propagation under Regulation 14, whether by freight, express or mail are moved to Washington or San Francisco in a manner similar to class 3.

The fourth safeguard is disinfection. This, where necessary, is performed by vacuum methods for any material reaching the inspection house at Washington or for such other material as requires disinfection at the port of first arrival. For example all seeds from the Orient and from out of the way countries receive cyanide fumigation with a vacuum.

The fifth safeguard is field inspection for one to five years in the growing season of the plants imported under Regulation 14 for propagation. Federal inspectors visit the nurseries.

The sixth safeguard is the force of port inspectors who prevent the entry of plants and plant products other than as provided in the regulations, who assist the customs officers in the search of passengers baggage, crew's quarters and ship's stores and who are constantly searching for possible loopholes by which plant diseases or insect pests may enter the United States.

Interceptions of plant diseases or insects such as are reported to you by the Pathologist or by the Entomologist of the Board may therefore come from several sources:

(1) From Federal Inspectors or State Collaborators at ports of first arrival.

(2) From State Inspectors at the destination of the material.

(3) From Federal Inspectors at Washingtom, D. C. or San Francisco, California.

(4) From Federal Inspectors working over propagating stock in the field during the growing season.

Since a report on plant interceptions was not made in 1921 I append a list of important interceptions of plant diseases during the last two years together with the country of origin of each.

List of Plant Interceptions in 1921 and 1922

Host	*Disease*	*Country*
Agropyrum scabrum	Urocystis agropyri	Tasmania
Citrus aurantium	Pestalozzia sp.	Canal Zone
Citrus grandis	Cladosporium citri	Mass., Hawaii, Cuba
" "	Pseudomonas citri	Siam
" "	Phomopsis citri	Brazil, Porto Rico
Citrus sinensis	Phomopsis citri	Panama, Cuba.
Citrus sinensis	Bacterium citri	Japan
Citrus	Pseudomonas citri	Japan (2)
Citrus	Phomopsis citri	Japan

Host	*Disease*	*Country*
Citrus nobilis	Cladosporium citri	Japan
Cocos nucifera	Colletotrichum	Cuba
" "	Pestalozzia	Cuba
Cucumis melo (Honey dew melon)	Alternaria sp.	Africa
Cydonia vulgaris	Sphaeropsis malorum	Argentina
Dianthus caryophyllus	Heterosporium echinulatum	England
" "	Uromyces caryophyllinus	France
Dracaena torminalis	Aspergillus niger	Brazil
Dracaena massangeana	Aspergillus niger	Brazil
Hordeum sativum (seed)	Ustilago hordei	Chile, Africa
Houttuyinina cordata	Botrytis cinerea	England
Galanthus elwesii	Penicillium (Hard rot)	Holland
Garcinia mangostana	Diplodia mangostana	Dominican Republic
Ipomoea batatas	Fusarium sp.	Africa
" "	Diplodia tubericola	Mexico
" "	Heterodera radicicola	Bahama
" "	Sphaeronema fimbriatum	Jamaica
" "	Penicillium sp.	Africa
" "	Rhizopus nigricans	Africa
Iris sp.	Botrytis parasitica	France, England
"	Vermicularia liliacearum	France, England
Iris siberica	Botrytis parasitica	England
Iris, Mrs. E. Sanders	Botrytis parasitica	England
Iris, Var. Finali & Balkana	Sclerotium (?)	Holland
Solanum tuberosum	Fusarium sp.	Germany
" "	Rhizoctonia solani	Germany
" "	Actinomyces scabies	Holland (2), Ireland
" "	Botrytis (sclerotium)	Peru
" "	Spongospora subterranea	Poland
" "	Fusarium sp.	Spain
" "	Stysanus stemonites	Spain
Tagua (nuts)	Coremium borzianum	Panama
Triticum aestivum	Tilletia	Africa
Tulipa sp.	Botrytis parasitica	Holland
Tulipa sp.	Botrytis tulipae	Holland
Tulipa sp.	Penicillium sp.	Holland
	PACKING	
Phragmites phragmites	Claviceps microcephala	Holland
Agropyron repens	Puccinia graminis	Geneva, N. Y.
Triticum	Puccinia graminis tritici	Australia
Triticum	Ustilago tritici	Australia

MR. P. A. GLENN: I have often wondered what method of procedure is taken when any of the pests in the list have been intercepted.

What do you mean by interception? That they are found, or excluded.

Mr. R. Kent Beattie: If a pest is intercepted at the port of first arrival, then the material, unless it can be safeguarded, does not enter the United States. If it is on material against which there is a special quarantine, it cannot enter anyhow, except when the importation is made by the United States Department of Agriculture.

If the material is found by the state inspector at the final destination, the state inspector, we assume, safeguards the material, either by destruction or disinfection, as he may think desirable. If the pest is found by Federal inspectors at Washington, D. C., or at San Francisco, the material is given the very best treatment that we know how to give it to eliminate the pest. If, for example, there is found in certain special permit material an aphis that our inspectors know how to destroy by fumigation, the material immediately receives vacuum fumigation. If a fungus disease is found which we know how to destroy by some treatment, the treatment is given. If we do not know how to destroy the pest, the material is returned to the country of origin or destroyed.

If one of our representatives in the summer field inspection finds a pest, we have the power furnished by special agreement, in every contract issued between the importer of special permit material and the Federal Horticultural Board, to go into that man's nursery and either cause a treatment to be given or to cause destruction, if necessary, of the material concerned. This is not merely based on the quarantine, but on an agreement which the importer has signed and has given us a bond to enforce.

The point to the whole thing is this: the pest must be kept out. At the same time, if it is safe to bring the material in, we wish to help the nurserymen to bring it in, but never at the expense of infesting the country. We have had to destroy very few shipments at the inspection house. For example: One shipment of bulbs which came from Mexico for propagation purposes in this country was so badly infested with an insect that the material was ordered destroyed.

We have, of course, a large force of men in the Bureau of Entomology and the Bureau of Plant Industry, who are experts in insect pests or fungus diseases. Whenever a pest is collected that we do not recognize, it is sent to the experts of these Bureaus for determination. We get all the facts we can. We get immediate determinations because plant material cannot be delayed. It must move.

The stories that you may have heard about the great delays in our inspection house are without foundation. At the time the alleged delays were occurring, it was the expressmen's strike in New York City that made the trouble—and we were, of course, getting the blame.

The facts of the case are that many of the shipments, even large ones, go out of the inspection house the same day they are received, and practically all except the very largest go out by the next day.

There are occasional shipments that cannot be worked in that length of time, but they are always worked promptly. We are handling the shipments by the very best methods that we know. Many nurserymen tell us that the packing we give to the material is far better than that given to it originally in the foreign country. Some of the foreign packing is awful. If we couldn't give better packing than the foreign shipper sometimes does we ought to go out of business.

We are developing some very interesting comparisons between foreign and domestic methods of packing. Some of the nurserymen with the best reputations abroad are the poorest packers, and some with less of a reputation pack better. Some countries pack better than others. We are learning these things, because now propagating material is going through one funnel where the various lots are coming side by side. Instead of assembling the information from forty-eight different groups of inspectors, one group of men now see practically everything in propagating material which enters the country. We are photographing these things and keeping records of them. We are eliminating pests wherever it is possible to eliminate them, and if we can't eliminate them, then the material is excluded.

Mr. R. Kent Beattie: Let me digress and say in closing that in the last year I have had the privilege of meeting with the group of men represented by Mr. Rockwell, in New York City and again in Detroit. There is no group of men in the United States who are more in sympathy with our work as inspectors than these producers of plants. They are not men who are jobbing plants, but they are growing plants and selling them, and I bespeak for Mr. Rockwell the most cordial sympathy of this organization because there is a unanimous feeling among these producers that we are their friends and are doing everything we can to help them and that they wish to co-operate with us. If there are any methods of protection that we can furnish which will help the nurserymen, they want them. They do not want to increase their risks.

Chairman E. N. Cory: Mr. E. R. Sasscer will give the next paper on the program.

IMPORTANT FOREIGN INSECTS COLLECTED ON IMPORTED NURSERY STOCK IN 1922

By E. R. Sasscer

Abstract

This paper is primarily a summary of the more important insects intercepted on foreign nursery stock arriving in the United States in 1922. A more or less complete list of the insects and plant diseases intercepted on foreign plants and plant products during the calendar year 1922 will be issued in the near future by the Federal Horticultural Board in the form of an Annual Letter of Information. This letter will list the insects by the country of origin, and will also indicate the hosts.

It is obvious from the partial list of insects which follows, that the condition of plants and plant products, as regards insect infestation, has shown little, if any, improvement over past years.

The sorrel Cutworm, *Acronycta rumicis* L., was intercepted on four shipments of fruit and rose stocks from France, and 156 nests of the White Tree Pierid, *Aporia crataegi* L., were taken on shipments of fruit and rose stock arriving from France. As previously indicated[1], literature fails to record this insect as being established in the United States. Also, two shipments of fruit stocks from France bore nests of the Brown Tail Moth, *Euproctis chrysorrhoea* L. *Emphytus cinctus* L., arrived on 26 separate shipments of Manetti stocks as follows: England 8, France 10, Holland 5, Ireland 3, and the Oriental Fruit Moth, *Laspeyresia molesta* Busck, and *L. pomonella* L., were found in shipments of pear from Japan and apple from New Zealand, respectively. The eggs of the European Lackey Moth, *Malacosoma nuestria* L., were intercepted on two shipments of fruit stocks from France.

White Flies were intercepted on a number of occasions as follows: The Citrus Black Fly, *Aleurocanthus woglumi* Ashby, was intercepted on foliage of plants arriving either as ships' stores or passengers' baggage: Cuba 5, Jamaica 4, Nassau, Bahama Islands 3, on *Citrus* sp., Coffee, Jasmine, Avocado, and *Stephanotus* sp., from Cuba; on Lime, Grapefruit, Mango, and Papaya from Jamaica; and on Sapodilla, Canipe, and spice from Nassau, Bahama Islands. The Woolly White Fly, *Aleurothrixus howardi* (Quaint.), was taken on five occasions on citrus foliage from Cuba and once on banana from Porto Rico; and Cardin's Whitefly, *Aleurodicus cardini* Back, was taken on guava arriving from the same island. *Lithraea caustica* from Chile was infested

[1] Jr. Ec. Ent., Vol. XV, No. 1, p. 120 (1922).

with *Aleuroparadoxus punctatus* Q. and B., and citrus foliage from Cuba was on four occasions infested with *Dialeurodes citrifolii* (Morg.). *Aleurothrixus floccosus* (Maskell) was intercepted on *Citrus* sp. from Porto Rico.

The Sweet Potato Weevil, *Cylas formicarius* (Fab.), was taken on sweet potatoes on 16 occassions—from China 5, Cuba 5, Nassau, Bahama Islands 4, and Haiti 2. The West Indian Sweet Potato Weevil, *Euscepes batatae* Waterhouse, was also taken in sweet potatoes which arrived from Brazil, Trinidad, and twice from Barbados.

Soil which arrived with plants in passengers' baggage was found on two occasions to be infested with larvae of *Agriotes lineatus* L., from Finland and Switzerland, and an unrecognized species of *Agriotes* was found in sand used as packing around dahlia roots from England, as well as a species of *Limonius* in soil about the roots of Scotch heather also from England.

The European Earwig, *Forficula auricularia* L., which in recent years has caused a considerable amount of injury in Seattle, Washington, was discovered in two miscellaneous shipments of bulbs arriving from Holland. It has been felt for many years that this insect gained entry into this country in soil, and in fact, there are instances on record that it can be, and is, carried by soil; however, this appears to be the first record of its arrival with bulbs.

Cocos nucifera from Cuba has been found to be infested with the following Thrips: *Franklinothrips vespiformis* (Crawford), *Haplothrips merrilli* Watson (4), and *Symphothrips punctatus* Hood and Williams; and bananas from Roatan, Honduras were infested with *Metamasius* sp. The Tahiti Coconut Weevil, *Diocalandra taitensis* (Guer.), has also been collected from the former host from Hawaii. Fibre plants from Columbia, arriving in Washington, D. C. were found to carry the workers of *Nasutitermes* sp., a genus which does not occur in the United States, and is considered a destructive wood borer and injurious to plants.

Two large shipments of broom corn arriving from Hungary during the year were found to carry a large number of living larvae of the European Corn Borer, *Pyrausta nubilalis* Hubn. As a condition of entry, this corn was carefully sterilized with live steam, preceded by a vacuum.

Had it not been for the vigilance on the part of an inspector of the Federal Horticultural Board, located at Baltimore, Maryland, it is possible that the Pink Bollworm, *Pectinophora gossypiella* Saund., would

now be established in Mississippi. This one interception revealed some fifty odd packages of cotton lint and seed which bore living larvae, pupae, and adults of the Pink Bollworm. This collection of seed, while very innocent in appearance, would no doubt have resulted in an enormous tax on the part of cotton growers, had it been permitted to reach its ultimate destination.

The following incident illustrates the possibility of introducing the Pink Bollworm in cotton and cotton waste used for packing. A collection of souveniers arriving in New York from St. Kitts was packed with cotton lint which contained seed infested with living larvae of the Pink Bollworm. The package in question was in the possession of a passenger and was intercepted in the course of inspecting passengers' baggage for contraband material. The Pink Bollworm, in addition to the instances referred to above, was collected in cotton seed arriving from the following countries: Brazil 1, Egypt 4, Porto Rico 1, St. Kitts, British West Indies 1. It was also found in cotton bolls from Hawaii.

Even though it was possible to make only a cursory inspection at the port of entry, Narcissus bulbs arriving from Holland were repeatedly found to be infested with the larvae of the Lesser Bulb Fly, *Eumerus strigatus* Fallen. The same type of bulbs from France and Holland were also infested with the Narcissus Fly, *Merodon equestris* Fab. A fairly careful examination of bulbs arriving in Philadelphia revealed an infestation ranging from one to twelve and one-half per cent. The larvae of both insects were present in this shipment. A similar, but smaller shipment of French bulbs (infested with *Merodon equestris* Fab.) which arrived in New York, was examined with equal care, and the results indicated that in five cases examined, the infestation ranged from two to five percent.

Iris rhizomes from England, Holland, and France arrived on a number of occasions infested with *Anuraphis tulipae* Boyer, and roots of this plant from England were also found infested by *Micromyzus tulipaella* (Theo.). The Bulb Mite, *Rhizoglyphus hyacinthi* (Boisd.) was found on a great variety of bulbs; in fact; it is perhaps safe to state that every commerical shipment of bulbs of any size arrives infested with this mite. Injury by this mite has during the past year been reported from Colorado, where it is stated that it caused the loss of an entire crop of lillies. Incidentally, it has also been recorded as injuring smilax and asparagus ferns in Pennsylvania.[2]

Scale insects continue to arrive on plants of various descriptions.

[2]Jr. Ec. Ent., Vol. XV, No. 2, April 1922, p. 179 (Primm).

No attempt will be made to compile a complete list of these interceptions in this paper, only what appear to be the more important ones being listed below. A full list will appear in th Annual Letter of Information which will be issued early in 1923.

DIASPINE SCALES

Insect	*Host*	*Origin*
Aspidiotus orientalis Newst.	*Cocos nucifera* (3)	Nassau, Bahama Is.
" *palmae* Morg. & Ckll.	Camphor leaves	Jamaica
" *persearum* Ckll.	*Cocos nucifera*	Hawaii
" *subsimilis anonae* Houser	Bobug (?)	Nueva Gerona, Isle of Pines
" " " "	*Annona muricata*	Roatan, Honduras
" " " "	" " (2)	Havana, Cuba
" " " "	" *squamosa*	" "
" " " "	" *cherimola*	" "
" " " "	Cuttings of ?	Santiago de Cuba, Cuba
Chrysomphalus scutiformis Ckll.	Banana (13)	Central America
Lepidosaphes albus (Ckll.)	Manihot cuttings	Brazil
" *conchiformis* (Gmel.)	Taura-mume (pear)	Okitsu, Japan
" *ficus* (Sign.)	Fig	Italy
" *mcgregori* Banks	*Cocos nucifera*	Guam
" *perlonga* (Ckll.)	*Baccharis cordifolia*	Argentina
Leucaspis cockerelli (de Charm.)	Palm (2)	Brazil
Morganella longispina (Morg.)	*Nerium oleander* (4)	Bermuda
Odonaspis pencillata (Green)	*Phyllostachys pubescens*	China
Parlatoria calianthina B. & L.	*Crisomelo monica*	Rome, Italy
" " "	Olive	Madrid, Spain
" *pyri* Marl.	*Pyrus baccata* (Crab apple) (Red Fruit)	Chefoo, China
" " "	Dragon-clawed date	" "
Phenacaspis eugeniae (Maskell)	*Cocos nucifera*	Hawaii
" *inday* Banks	" " (2)	"
Pinnaspis buxi (Bouche)	Ornamental palm	Porto Rico
Pseudaonidia articulatus (Morg.)	*Citrus grandis*	Porto Rico
" " "	" *sinensis*	" "
" " "	Mango (4)	Jamaica
" " "	*Coffea robustus*	"
" " "	*Citrus sinensis* (2)	"
" " "	" *nobilis*	"
" " "	*Annona muricata*	"
" " "	Jamaica tangerine budwood	"
" " "	*Citrus* sp.	"
" " "	*Livistona chinensis* seed (2)	"

Pseudaonidia articulatus (Morg.)	"Ackee"	Jamaica
" " "	*Musa* sp. (5)	Central America
" " "	*Acalypha*	Cuba
" " "	*Annona squamosa*	"
" " "	*Caladium* (?)	"
" " "	*Citrus nobilis*	"
" " "	*Citrus sinensis*	"
" " "	*Cocos nucifera*	"
" " "	*Croton* sp.	"
" " "	Mango	"
" " "	Palm	"
" " "	Screw pine	"
" " "	*Citrus aurantifolia*	Barbadoes, B.W.I.
" " "	*Achras sapota*	Bahama Islands
" " "	Canipe	" "
" " "	*Cirtus* sp.	" "
" " "	*Rosa* sp.	" "
" " "	Spice (2)	" "
" " "	*Tamarindus* sp. (3)	" "
" " "	Unknown	" "
" *clavigera* Ckll.	*Hibiscus* sp. (6)	Hawaii
" " "	*Castanea javanica*	"
" *duplex* (Ckll.)	Gumamela-Purple	Philippine Island
" *paeoniae* (Ckll.)	*Azalea Koreense*	Japan
" " "	" *kurume*	"
" " "	"	"
" " "	? plant	"
" *tesserata* (de Charm.)	*Lycidice rhodostegia*	Ceylon
Pseudaonidia trilobitiformis (Green)	*Citrus aurantifolia*	Barbados, B.W.I.
" " " "	" *nobilis* (2)	Japan
" " " "	" *sinensis* (3)	"
" " " "	" sp.	"
Pseudischnaspis alienus (Newst.)	*Annona cherimola*	Cuba
" " "	" *squamosa*	"
" " "	*Rosa* sp.	"
" " "	Unknown	"
" *bowreyi* (Ckll.)	Cherimoya fruit	"
" " "	Mango	"
" " "	Jasmine	"
Targionia hartii (Ckll.)	Barbados red yam	Barbados, B.W.I.
" " "	Yam tubers	Montserrat
" " "	*Dioscorea alata* (2)	India
" *sacchari* Ckll.	*Saccharum officinarum* (2)	Nassau, Bahama Islands
" " "	*Dioscorea* sp. (Yam)	Cuba
" " "	*Saccharum officinarum*	"
" " "	" "	Jamaica

Non-Diaspine Scales

Asterolecanium aurem (Bvd.)	Dwarf *Chamaedorea* seeds	Guatemala
" *miliaris* Bvd.	*Bambusaea* sp.	Cuba
" " "	Bamboo	Bermuda
Coccus mangiferae (Green)	*Cinnamomum zeylanicum* (Cinnamon tree)	Jamaica
Coccus viridis (Green)	*Citrus aurantifolia*	Barbados, B.W.I.
" " "	*Achras sapota*	Bahama Islands
Lecanium coryli (Linn.)	*Tilia dasystila fastigiata lacincinata*	Czecho-Slovakia
" " "	Cherry	" "
" *kunoensis* Kuwana ?	*Pyrus baccata* (Crab apple White Fruit)	Chefoo, China
Pseudococcus maritimus (Ehr.)	*Musa* sp. (banana)(8)	Central America
" " "	Pears	New Zealand
Pulvinaria floccifera (Westw.)	Orchids	England
Ripersia palmarum Ehr.	*Cocos nucifera* (12)	Hawaii

Summary of Countries and the Number of Species of Insects Reported by State and Federal Inspectors During the Calendar Year 1922

Africa	16	Cook Islands	2
Algeria	2	Costa Rica	14
Argentina	13	Cuba	97
Australia	12	Czecho Slovakia	14
Austria	2	Denmark	4
Azores	9	Dominican Republic	13
Bahamas	34	Dutch Guiana	6
Barbados	12	Ecuador	1
Belgium	5	Egypt	13
Bermuda	26	England	95
Borneo	5	Federated Malay States	1
Brazil	22	Finland	5
British Columbia	9	France	52
British East Africa	2	Germany	40
British Guiana	1	Grand Cayman	2
British Honduras	2	Greece	1
British West Indies	3	Guam	13
Canada	2	Guatemala	24
Canal Zone	3	Haiti	14
Canary Islands	3	Hawaii	78
Central America	21	Holland	60
Ceylon	32	Honduras	7
Chile	11	Hungary	1
China	57	India	17
Colombia	31		

Ireland	11
Isle of Pines	10
Italy	42
Japan	59
Jamaica	116
Java	18
Luxemburg	1
Malta	1
Martinique	5
Mexico	55
Morocco	2
New Zealand	4
Nicaragua	6
Norway	7
Nova Scotia	14
Orient	2
Palestine	7
Panama	7
Peru	4
Philippine Islands	32
Poland	1
Porto Rico	26
Portugal	3
Samoa	2
Scandinavia	2
Serbia	1
Siam	3
Sicily	3
South Africa	5
South America	2
Spain	13
Spanish Honduras	10
St. Kitts	2
Straits Settlements	2
Sudan	4
Sweden	6
Switzerland	5
Tahiti	3
Tongatabu Islands	7
Trinidad	11
Turks Island	3
Uruguay	1
Venezuela	1
Virgin Islands	6
Wales	1

CHAIRMAN E. N. CORY: The next paper will be by Mr. T. J. Headlee.

THE PRESENT STATUS OF THE GIPSY MOTH IN NEW JERSEY

By THOMAS J. HEADLEE, *State Entomologist*

ABSTRACT

The large expenditures for control of gipsy moth, *Porthetria dispar*, have rapidly reduced the infestation, the Federal Government working in co-operation with the State of New Jersey. It is held that extermination is worth the cost, especially if a barrier zone be established in New York State.

The results of the extermination work against the gipsy moth in New Jersey are of such a character that they are deemed worthy presentation to the association.

As stated in previous reports this effort against the gipsy moth is a co-operative one in that it is jointly controlled and financed by the U. S. Bureau of Entomology and the N. J. State Department of Agriculture. Mr. H. A. Ames was only placed in charge of the promptly established

gipsy moth office at Somerville, N. J. Mr. Ames works under the general supervision of Mr. H. L. McIntyre, chief of the U. S. field service against the gipsy moth.

As the work has gone forward definite methods of record keeping have been developed and it has been deemed wise to make up the tabular statement in accordance therewith.

General Area[1]

Year	Funds Federal	State	Private	Amt. Expended for machinery
1920	117,000	112,000	25,000	109,000
1921	125,000	125,000		
1922	125,000	125,000		?

Sq. miles scouted.	Acres of woodland scouted.	Fruit trees examined.	Shade trees examined.	Number of burlap bands.
680	5,463			15,000
1,224	14,165	1,237,000	787,000	10,869
120	5,561			

No. of trees banded with	Tons of lead arsenate used	No. of acres sprayed.	No. of trees sprayed.
20,000	90	2.430	21,318
31,419	89	3.757	22,923

No. of Gipsy Moth Colonies.	No. of Gipsy Moth Egg Masses.
760	33,065
226	909
29	404

Isolated Areas

Year	No. of areas.	Acres of woodland scouted.	No. of colonies.	No. of egg masses.
1920	15		6	40
1921	15	194.5	0	0
1922	6	634.5	0	0

The preceding tables bring out the fact that while the amount of money being used is large the infestation is being rapidly reduced, both as regards number of colonies and number of egg masses. The data for 1922 is, of course, still very incomplete. The fact that with only about ¼ of the territory scouted 404 egg masses have been found, might lead one to conclude that more eggs will be found this year than last. One must, however, take into consideration the fact that much of the scouting in the general area this year has been done along the river banks

[1]Items of funds, machinery, banding, number of trees sprayed and lead arsenate used include the isolated areas as well.

where there is a heavy growth of large hollow trees in cavities of which the egg masses of last year were sheltered from the crews and that much of this growth could not be sprayed because of the feeding of herds of cattle in areas immediately adjacent thereto. This year a campaign of cutting this growth has been undertaken and is rapidly going forward.

Infestation in all outlying areas has been apparently cleaned up, the colonies have dropped from 760 to 226, and the egg masses from over 3,000,000 have been reduced to 909.

It is, of course, not sufficient to pursue a campaign of extermination in areas already known to be infested and territory bordering thereon, but one must make sure that no other infestations are in process of development and equally certain that no new establishments are taking place.

To handle this phase of the work against the gipsy moth a separate scouting crew is maintained and operated by the New Jersey State Department of Agriculture. This crew scouts the supposedly infested sections of the state, other than the territory bordering the infestations, which are being looked over by the co-operative force. It also examines all shipments of incoming plants and products deemed likely to carry gipsy moth.

The value of this supplementary work is shown by finding a year or more ago of one new but slight infestation and the interception of 14 cases of gipsy moth infestation on in-coming nursery stock.

The New Jersey authorities hold that the extermination of the gipsy moth within the state's borders is a good proposition and worth the money it costs even if the New England infestation does slowly move southward but they hold it to be far better business if an end can be put to this movement and a "Thou shalt not pass" line be erected and maintained somewhat on the lines laid down by Dr. Felt in his paper of yesterday. Not only should such a line as that suggested by Dr. Felt be established and maintained but all infestations beyond it should be promply exterminated.

In a meeting held at Albany recently and attended by Canada, New England, New York, New Jersey and United States Department of Agriculture representatives. It was planned:

(1) To exterminate the infestations in New York and New Jersey.

(2) To hem in the New England infestations by a "Thou shalt not pass" line.

(3) Exterminate all infestations that may later be found beyond it.

(4) Push this line toward the sea.

The New Jersey authorities believe that such a procedure is good business and will stand behind such a movement to the extent of their power.

Chairman E. N. Cory: We will now have a round-table discussion of nursery stock fumigation, led by Mr. G. F. Arnold.

UNIFORMITY OF NURSERY STOCK FUMIGATION REQUIREMENTS

By G. F. Arnold, *A. & M. College, Miss.*

Abstract

Recommendations for fumigating nursery stock in the different states vary considerably in the strength of hydrocyanic acid gas to use and the time of exposure necessary. The variations in temperature and humidity throughout the United States would not permit of standard fumigation regulations for the entire country. It would seem desirable for the states in each section (for example, the Southern States) to adopt similar fumigation requirements for each kind of plant to be fumigated. Suggest further experiments to determine the fumigation schedule that could be adopted in each group of states in the country.

The subject of uniformity of fumigation requirements for nursery stock was discussed at a meeting of southern entomologists and nurserymen held in Atlanta last May. The object of this meeting was to agree on a nursery inspection system which might be considered standard for the Southern States. The nurserymen and entomologists present thought that host plants of scale insects should be fumigated as a precautionary measure.

Several of the nurserymen inquired the strength of hydrocyanic acid gas necessary for the different kinds of nursery stock. The entomologists present differed considerably in their opinions on this point. The majority seemed to think that one ounce of sodium cyanide to each one hundred cubic feet of space was sufficient for such stock as dormant apple, plum, pear, quince, cherry, apricot and pecan. In one of the states represented the regulation dosage for dormant pecan stock is one and one-half ounces of sodium cyanide to each one hundred cubic feet of space. This dosage for pecans has been used in that state in fumigating large quantities of pecans for several years past and no injurious results have been reported.

It was brought out at the meeting that the regulations in the Southern States vary considerably in the dosage of cyanide prescribed for tender peach trees, usually termed "June-buds." Several of the entomologists

present stated that an ounce of cyanide to each one hundred cubic feet of space had been used in their states without injurious results. Others present stated that two-thirds of an ounce of cyanide was the dosage for this class of stock in their states. Some of the entomologists present were of the opinion that not more than one-half of an ounce to each one hundred cubic feet should be used for "June-buds," and said this was the dosage used in the states where they were employed.

The discussion about the amount of cyanide to use in fumigating peach stock was especially interesting to me, as the State Plant Board of Mississippi requires the full ounce of cyanide for this class of stock and one of the Alabama nurserymen shipping much peach stock into Mississippi had protested that this large dosage would either kill or seriously injure "June-buds." It seems that he based his opinions on statements made in a letter received from his brother, a fruit nurseryman in Colorado, who informed him that this dosage had injured peach trees fumigated in that state. In answer to an inquiry from me sent out in June relative to this matter, Mr. George M. List, the Colorado Inspector replied as follows:

> "This last spring we carried on a series of tests in fumigating dormant peach trees. This test included a variety of strengths ranging from three-fourths of an ounce of sodium and potassium cyanide to double this amount to each one hundred cubic feet of space. The exposure ranged from forty-five to ninety minutes. This was applied in both wet and dry stock. So far, one hundred percent of the trees are growing nicely in the nursery row."

The entomologists at the Atlanta meeting seemed to be agreed that one-half ounce of cyanide was sufficient for roses. Rose stock is not required to be fumigated in Mississippi except when scale is found on a block of stock to be offered for sale. On several occasions, San Jose Scale has been found on Rugosa roses in Mississippi nurseries, and fumigation with one-half ounce has been required.

The most extreme view to be expressed on fumigation requirements at that meeting was from the representative of the Louisiana Department of Agriculture. He pointed out that they had conducted experiments in New Orleans in co-operation with the United States Bureau of Entomology and had demonstrated that the Japanese Camphor Scale (*Pseudaonidia duplex*) could be controlled with a much lighter dosage than was being used to fumigate with in other states. Experiments showed that three-fourths of an ounce of cyanide to five hundred cubic feet was sufficient for hardy nursery stock while three-fourths of

an ounce to each thousand cubic feet for tender ornamentals was sufficient to kill the Japanese Camphor Scale. Judging by the numerous carefully conducted experiments made by these investigators, the Camphor Scale seems to be killed by as small a dosage as the above. It is my opinion that this small dosage would not be effective on Camphor Scale except under ideal conditions as regards humidity, temperature, tight fumigation house and extreme care on the part of the operator. Nor could such a dosage be expected to be of value against such scales as San Jose Scale (*Aspidiotus perniciosus*), Florida Red Scale (*Aspidiotus ficus*) and Dictyospermum Scale (*Chrysomphalus dictyospermi*). In fact, on several occasions inspectors of the Mississippi Plant Board have found specimens of some of the above scales in shipments of nursery stock from New Orleans accompanied by the special Louisiana certificate of inspection showing the plants to have been fumigated under supervision, and, when examined in the laboratory, the scales had the appearance of being alive.

Several of the nurserymen present at the Atlanta conference expressed the opinion that they could better comply with the fumigation requirements of the states in the South into which they ship nursery stock if the fumigation dosage prescribed was the same in all Southern States. The chairman of the meeting appointed a committee (on which I was included) to investigate this matter and then to recommend a standard fumigation dosage to officials in charge of the plant inspection work in the several Southern States.

In order to learn of the ideas on fumigation held by the plant inspection officials of the country, a questionnaire was mailed to the official in charge in each state. Replies to the questionnaire were received from practically all of the forty-eight states. The information when tabulated was of considerable interest, because it showed that there was much difference of opinion about the fumigation of nursery stock.

Replies indicated that several states in the East and Middle West had practically dispensed with fumigation for nursery stock for the reason that the San Jose Scale had become very scarce in their states. A number of other states recommend fumigation to the nurserymen, but do not make it compulsory except when scale is found in the stock of a nursery. A number of the states specify that all host plants of San Jose Scale should be fumigated as a precautionary measure. Pecan stock is required to be fumigated in a few of the Southern States.

The replies to the questionnaire showed that the dosage used in the

states varies considerably for the same kind of nursery stock. The following formula to the one hundred cubic feet is used by many of the states for dormant stock:

1 Ounce of Sodium Cyanide
2 Fluid Ounces of Sulphuric Acid
4 Fluid Ounces of Water

The amounts of acid and water considered necessary to generate the gas with one ounce of sodium cyanide varies in several states. Only one fluid ounce of sulphuric acid is used in some of the states, one and a half ounces in others, and three ounces in a few states in connection with the one ounce of sodium cyanide. The amount of water used with an ounce of the cyanide is only two fluid ounces in some states and three in others.

It is recommended in most of the states that exposure to the gas be from forty minutes to one hour. Many states consider a thirty minute exposure as ample, while on the other extreme one of the states in the Northwest specifies an exposure to the gas of ninety minutes.

Many of the State Inspection Officials have apparently overlooked the fact that sodium cyanide give one-fourth more gas than potassium cyanide. The fumigation dosages worked out years ago on the basis of potassium cyanide do not seem to have been lowered any by its replacement within recent years by sodium cyanide.

In my opinion, it would not be feasible for all the states in the country to attempt the adoption of a standard fumigation schedule for nursery stock. This is due chiefly to the great differences in humidity and temperature in the different states at the time the plants are fumigated. Experiments conducted by the Federal Horticultural Board at one of the Cotton Fumigation Plants in Boston demonstrate clearly that it is difficult to kill insects by fumigation when the weather is extremely cold. In these experiments Brown-tail moth larvae and European Corn Borers were subjected to a dosage of six ounces of sodium cyanide to the one hundred cubic feet in a vacuum for two hours with the result that at extremely low temperatures some of the larvae were still living at the conclusion of the experiments. Please note that this dosage is several times that ordinarily used for nursery stock, and it would appear doubtful whether nursery stock could survive so much hydrocyanic acid gas.

It would seem that the states in a group where the temperature and humidity conditions were very nearly uniform could adopt uniform fumigation regulations. For example, all Southern States should recom-

mend the same size dosage to nurserymen for the same kind of nursery stock.

One reason why this should be done is to insure all nursery stock shipped being fumigated with a sufficient dosage of gas to kill all the pests. Another reason is that the nurserymen would better comply with the fumigation requirements of the states in a certain group if the fumigation regulations in all were similar.

Some of the state plant inspection officials are of the opinion that dipping nursery stock in a miscible oil or oil emulsion is as effective as fumigation with hydrocyanic acid gas and even more satisfactory. This may be true, providing the dipping is carefully done. Dipping could probably be substituted for fumigation by the small nurserymen better than by the large nurserymen, since it is cheaper to fumigate a large quantity of trees than it is to dip them in a miscible oil or oil emulsion.

After having collected data from the several states on fumigation formulas in use, time required for fumigation and other information, and find that there is so much variation, one naturally hesitates to make any recommendations along the line of standard fumigation requirements for even a group of states. It would seem highly desirable that a number of experiments be conducted in several sections of the United States to determine what fumigation requirements might be considered standard in each group of states in the country.

Mr. E. R. Sasscer: I regret very much that we do not have more time to discuss this important problem. It is one which deserves more attention than it is receiving on the part of those requiring the fumigation of nursery stock as a condition of distribution. Mr. Arnold was good enough to permit me to examine the replies he received to a questionnaire, and I was astonished to discover that there are about as many formulae in vogue for the fumigation of nursery stock as we had in the old days for the preparation of lime sulphur and salt. It appears that many entomologists are unaware of the fact that at the request of Doctor Marlatt the United States Bureau of Chemistry worked out a formula which will give the maximum yield of gas from a given amount of cyanide. Information on this subject is given in Bulletin No. 90, Bureau of Entomology, published in 1912. In view of the thorough investigations made by the Bureau of Entomology in California and elsewhere there seems to be little excuse for the development of so many formulae.

Another very important point to be considered in fumigation work is the kind of cyanid used. I venture to say that there are very few entomologists who can indicate off-hand the cyanogen content of Sodium Cyanid satisfactory for fumigation purposes. When recommending the use of Hydrocyanic-Acid Gas to nurserymen, all entomologists should clearly indicate the cyanogen content of the cyanid to be employed, as well as the specific gravity of the Sulphuric Acid. The fact should also be borne in mind that the high grade Sodium Cyanid of today contains approximately one-third more available cyanogen than does high grade potassium.

Another factor which should receive serious thought on the part of officials requiring fumigation is the temperature at the time the work is performed. The effect that low temperatures have on fumigation results was well brought out by Mr. R. I. Smith in his paper which he read yesterday. In view of the results secured by Mr. Smith, I am inclined to believe that much fumigation has taken place in the past at temperatures so low that the gas was ineffective against San Jose Scale and other pests which may be distributed on nursery stock.

Another unfortunate situation which arises, is the inability of state entomologists to be present at the time the plants are fumigated. This work is turned over to the nurseryman, who probably assigns the actual fumigation work to a laborer.

Mr. C. L. Marlatt: In connection with this round table discussion, it might be well for a mmoent to refer again to the proposition Mr. Rockwell presented to the Section. We are all in agreement with the suggestion and it is a matter that has been discussed many times at our meetings. In connection with the original effort to secure national plant legislation, the bill which was drafted some 25 years ago dealt chiefly with the idea of governing the movement interstate, of nursery stock. The foreign features of the bill were almost negligible. It was an effort to get just what Mr. Rockwell has now suggested, national legislation to be enforced in co-operation with the states, to regulate the movement interstate of nursery stock.

The reason we failed to get this legislation 25 years ago was the lack of agreement of the nurserymen and others concerned. It may be advisable to call an interstate conference on the subject, to discuss it fully from the standpoint of the different state needs, and from the standpoint of the nursery interests, as a basis for a new bill to be presented to Congress; and with the support of the states and the other interests such legislation might now be obtained.

It is a big subject and it is a thing that cannot be easily accomplished, but it is one I think that there is no disagreement about.

Mr. F. F. Rockwell: I have no idea that the problem can be solved here, but I hope a resolution can be adopted showing that you accept the principles mentioned. As Dr. Marlatt has said, there are conflicting interests even among the nurserymen themselves that their own organization will have to try to take care of.

Mr. T. J. Headlee: I would like to offer a motion in order to get the sentiment of those present.

Resolved, That it is the sense of this Section that a uniform U. S. tag should be required for interstate movement of nursery stock, and that the qualifying inspection should be worked out between the United States Department of Agriculture and the state authorities.

The motion was carried.

Mr. T. J. Headlee: The motion passed is all right but it is another thing to get the machinery to carry it out. I would therefore move that the chairman be empowered to appoint a committee consisting of a maximum of 5 to see what can be done toward working out this proposition along practical lines.

The motion was carried.

Chairman E. N. Cory: The chairman, with the approval of President Ruggles, appointed the following members of this committee: T. J. Headlee, Chairman, F. M. O'Byrne, G. M. Bentley, E. C. Cotton and E. R. Sasscer.

We have a committee that was appointed last year to consider the possiblity of greenhouse inspection. Mr. E. R. Sasscer is chairman and I would like to hear from him at this time.

Mr. E. R. Sasscer: The committee mentioned was appointed last year. It was unfortunate in a way that the motion provided that the membership should be distributed geographically, This has made it necessary for the committee to depend entirely on correspondence, as it has never been able to meet. The problem is so complex that it is not possible to make a definite report at this session. I would request that the committee be continued to report next year, if possible.

Upon motion, it was so voted.

Chairman E. N. Cory: We will now listen to the report of the Nominating Committee.

Mr. W. E. Britton: The committee recommend for chairman, Mr. P. A. Glenn; for secretary, Mr. E. R. Sasscer.

On motion, the ballot was cast and these officers elected for the ensuing year.

There being no further business, the session adjourned at 1:30 p. m.

Afternoon Session, Friday December 29, 1922

The meeting was called to order by President Sanders at 2:00 p.m.

President J. G. Sanders: At the last annual meeting of this association, it was voted to hold a symposium on "Standards for the training of men who are to enter professional entomology." The papers will be presented as listed on the program and discussion deferred until after the last paper has been read.

I will now call on Professor Herbert Osborn for the first paper.

STANDARDS FOR THE TRAINING OF MEN WHO ARE TO ENTER PROFESSIONAL ENTOMOLOGY
PERSONAL CONTACT WITH STUDENTS

By Herbert Osborn, *Columbus, Ohio*

Abstract

Earlier entomologists presumably had not set standards for training. The problem of standards is worth careful discussion. A great part of our knowledge is gained through personal contact and we lose in proportion as it becomes impossible. The advanced courses permit closer contact; there is also contact later with station and extension workers. Teachers in vocational agriculture frequently have opportunities to discover latent talent. There should be helpful contacts between entomologists and their assistants, partaking of the educational. There is no more ideal training than under the tutelage of a man of large experience. One method of obtaining this is through summer assignments with the Bureau of Entomology or Station Entomologists.

Among the earlier workers in Entomology in America I think we may assume there was no thought of any set standard to be met and State entomologists, museum curators and teachers were employed, where employed at all in a professional capacity, on the basis of their interest in the subject and the proficiency they had shown to others more or less familiar with the requirements of such work.

With an ever increasing demand for competent entomologists and with advancing ideals as to the qualifications necessary for efficient work it is natural to enquire whether it is possible to establish any standards to assist in the selection or recommendation of candidates for the varying demands of different positions. Are such standards as are commonly in use, in medicine, law, engineering and other fields available and if so can we adjust our systems of entomological training to meet such standards. It is a question well worth discussion, for the

future progress of our science is closely linked with the quality and training of the men who are preparing to devote their lives to effort in this field.

Whatever we may believe as to the desirability of the standardizing of our entomological training, whether we favor a large freedom in the basic courses or would insist on rigid training in certain technical details that appear important or imperative I presume there will be no great difference of opinion when we consider the personal equation and recognize the place that the teacher must occupy in any scheme of training that may be devised. Not only technical training but personal character must enter into the equipment of a successful professional worker. So I anticipate no very serious opposition in the discussion of my topic in this symposium.

I suppose no argument is necessary to show that a great part of our knowledge is gained by personal contact with some teacher. The biographies of conspicuous figures of all ages prove that they have received their impulse or direction from some more experienced person or that they have in turn been the stimulating force for many followers. Probably every one present looks back to one or a number of teachers who have given the initial impulse or the guiding force in shaping his own career. Other factors may play a large part in individual cases, and we can allow for the exceptional genius who seems to have blazed his own trail in unknown territory but to the great majority the personal approach is a most essential part of our systems of education.

This does not mean that individuals must always be related as teacher and pupil or have this contact under the formal methods of any kind of school. Indeed some most striking cases of inspiration and direction are found entirely outside the halls of learning.

Under our modern conditions of education there is less of opportunity for contact between teacher and pupil especially in all the lower grades of school work, and it seems to me that we have lost proportionately in the personal influence of teacher upon the pupil. Perhaps the most ideal condition for certain phases of education was found in the system of tutor and pupil with practically a personal direction for each individual. This of course restricted the educational effort to the favored few and we cannot regret the change which has given us a greater degree of universal education even if we have lost some of the advantages of the individual training. I once heard a distinguished educator remark that he believed that music was better taught than any other subject because of the individual direction in vogue with that subject. How-

ever that may be, we can appreciate the advantage of the direct contact which enables the teacher to understand the personality of the pupil and to guage his instruction by the ability and interest which he manifests.

In our biological work we have found a great advantage in the use of field courses or summer laboratory courses where, in addition to the direct contact with the subject, we have much more opportunity for the direct relationship between teacher and pupil. I do not think anyone will deny the great advantage from this sort of instruction and it is unfortunate that it cannot be applied to larger numbers of students in High School or the lower classes of College work.

As we come to the more advanced work of College and University classes we have of course opportunity for closer contact between instructors and students but many students who might have been attracted to entomology had they had the proper contacts have missed any such knowledge of the subject as would attract them to it as a career. Considering such students as do come to these higher courses I think we can hardly overstate the desirability of a close and friendly contact between teacher and pupil, and such sympathetic encouragement as will carry the student forward to a full appreciation of the subject.

Independent of the normal class-work there are many avenues through which instruction may reach individuals even if not considered primarily as students. It seems to me that we can emphasize the opportunity for station and extension workers in the students point of view, and to cultivate a far greater acquaintance of our subject. It is very evident that our success in securing the adoption of our control measures, is very dependant upon the ability of the public to understand the measures advocated and in some degree to appreciate the basis for such recommendations as are named. Moreover, the station and extension worker in addition to work with mature individuals is almost certain to have frequent contact with younger persons, perhaps still in the student stage who may be greatly influenced by suggestions and encouragement in the direction of thorough study of entomological problems.

It is in this way that we may hope to recruit promising men for the coming demands in entomology.

The teachers in vocational agriculture also have an opportunity to discover latent talent in such work and may be instrumental in starting pupils on an important career.

Another phase of contact is to be noted between entomological

workers and their assistants or helpers. In the great majority of cases I believe it is only fair to the assistant to count him in part as a student, a man to be encouraged and stimulated with the idea that he is to advance to larger opportunities and greater responsibilities.

I would suggest therefore, that every station and extension worker, or for that matter every entomologist who may find opportunity for contact with interested individuals should think of himself as a teacher and do his utmost to interest and encourage the individual. He can reflect that many of our most useful workers have been discovered in this manner.

Assuming that these general statements may be accepted there is still the practical question as to whether the opportunities for personal contact between the teacher and the entomological student are all that they should be or whether there are opportunities for improvement in our present systems.

I can think of no more ideal plan of training than for an ambitious student with a clear conception of what he wishes to prepare himself to do coming under the tutelage of a man of larger experience and training in the subject, himself alive to the opportunities for growth in his chosen field and ready and willing to impart his knowledge to those who seek it.

In such conditions there is no close figuring on hours to spend or credits to be received but a mutual give and take, in an association of pleasure and of profit to both teacher and student. Imagine if you can such an association as Benjamin D. Walsh with the youthful C. V. Riley debating as to hours and credits or thinking of any limitation but physical barriers of strength and time in their study.

Now there are manifest difficulties in adapting this method in college schedules but somewhere in the training of the entomologist there should be an opportunity for the student to come under the direct guidance and inspiration of the more experienced worker. One of these opportunities is afforded when the student is assigned to summer or vacation work with the Bureau of Entomology or Experiment Station entomologist. The success of the plan is dependent upon the character of the men and in large degree upon the seriousness with which the older worker views his responsibility to the student. Naturally the men responsible for making such connections must use careful judgment in arranging the combinations.

The contacts, possible with advanced students in the college or university have already been suggested. Such contacts naturally in-

creases as the student progresses to special and research courses and the opportunity for stimulating contact may reach its climax in the graduate work in special problems where the instructors personal interest in an investigation may blend with those of his pupil. The value of this contact is unquestioned but in a way it seems regrettable that it comes at a time when the student may be least in need of it. If the budding entomologist has overcome the pitfalls of his earlier educational career he is in a pretty fair way to steer himself through the later processes. The means to reach the potential entomologist in his early years of student life, except for the rare cases where he is already fixed in his purpose to prepare for this profession are not clear. I can suggest nothing better than that biological teachers strive to present their subject in such manner as to stimulate the latent interest of the student and be alert to recognize and encourage talent whenever it appears.

It must be very manifest that I have only touched upon certain phases of this subject which might be indefinitely expanded but I trust some of the suggestions may find their place with other topics of this symposium and possibly help in an appreciation of the problems to be met in the preparation of entomological workers.

THE NEED OF CHEMISTRY FOR THE STUDENT OF ENTOMOLOGY

By William Moore

Abstract

The economic entomologist should be well grounded in chemistry, especially organic and physical chemistry for the purpose of enabling him to see and solve the problems in connection with the use of insecticides.

Introduction

The economic entomologist justifies his work and makes his claim for federal and state funds upon his ability to make sound recommendations for the control of various insect pests. Altho parasites may hold in check certain insects and the damage from others may be reduced by proper cultural methods, the burden of control rests upon the use of insecticides. Progress in the development of insecticides and a knowledge of their action has not kept pace with the development of other phases of economic entomology. The failure of the entomologist to make greater progress in the development and use of insecticides is no doubt due to his lack of chemical knowledge. The chemical training of the entomologist in the past has been so meager that he makes and

recommends mixtures of insecticides and fungicides which are not only incompatible but even useless and in many cases harmful to the plant. One could easily offer an excellent argument, showing the need of more chemical training in the course of study of the young entomologist, by presenting a series of quotations from the writings of current entomologists. Such a paper might not meet with hearty approval. I shall therefore try to outline some of the problems and difficulties encountered in the use of insecticides and permit you to judge whether the economic entomologist has sufficient chemical knowledge to solve them.

Physical Variations in Insecticides

Solutions of electrolytes and non electrolytes, colloidal solutions, emulsions, and suspensions are all represented among the common liquid insecticides. The effectiveness of the spray often depends upon its physical rather than its chemical nature. Emulsions are often more effective than solutions, and even the character of the emulsion has an influence. Emulsions with very small particles will behave differently from one with large particles. Recently an oil company has prepared an oil which mixed with water forms a system with particles so small that it may be classed as a colloidal solution or emulsoid. The water can be evaporated from this colloidal solution without destroying the original properties of the oil. Lime may even be added to the solution and the oil will not collect in a film on the surface until several hours have elapsed.

An emulsion of water in oil can easily be made and might be a far more effective insecticide than the ordinary emulsion in which the oil is the disperse phase. No one to my knowledge has ever tested such an emulsion to determine its effect on insects or plants.

Recently it has been shown that by the use of a protective colloid, in the manufacture of lead arsenate, a more finely divided material could be prepared. The reduction of the size of the particles should increase their solubility and possibly their toxicity but may not the presence of the protective colloid more than neutralize this advantage?

If a soluble salt is present in a suspension of a slightly soluble arsenical, having an ion in common with it, the solubility of the arsenical will be reduced. Such a salt may be present at the time the arsenical is tested for water soluble arsenic with the result that little or no soluble arsenic will be found. After the spray is applied to the foliage the soluble salt may be washed away by rains or dews or may be changed to a less soluble form with the result that the plant is severely burned.

The smaller particles in a dispersion of a slightly soluble material upon standing will grow smaller while the larger particles will grow larger. If the material is a solid there will be difficulties in keeping it in suspension, if an oil, the emulsion will break.

The particles in a suspension may carry a positive, a negative, or no electric charge. The character of the charge frequently controls the adherence of the particles to the sprayed plant.

Surface tension determines whether the arsenical spray will form a thin film over the leaf surface or roll off in the form of drops. It also largely determines the effectiveness of the contact spray and the cattle dip.

The phenomenon of adsorption plays an important role in limiting the value of soil insecticides, nicotine dusts, and certain fumigants. There appear to be several types of adsorption and it is only by a thorough knowledge of this phenomenon that its effect may be overcome.

Two compounds of the same composition may be optically active or inactive. It has been shown that, of the optically active compounds, the laevo rotatory are more toxic to both animals and plants than the dextro rotatory. To what extent has this physical property been considered in the use of insecticides.?

Chemical Reactions of Insecticides

In order that the cost of application be reduced entomologists frequently recommend the combination of two or more insecticides and fungicides. Some of these mixutres are made without regard to the incompatibility of the materials or the chemical reactions which may reduce their efficacy. Such an incompatible mixture as lead arsenate, lime sulphur, nicotine sulphate, and soap has been recommended. In other cases lime is added to lead arsenate in such large quantities as to almost entirely destroy its insecticide value. Lime sulphur is used with lead arsenate without regard to the many and complicated chemical reactions which occur. In these days when dry mixtures of lead arsenate, lime, sulphur, and calcium caseinate are coming to the front, the question of the reactions between these ingredients should be carefully considered. When mixed and stored for a short time in a tight container one series of chemical reactions occur, while if stored in the open an entirely different series of reactions take place. In neither case would the final product be similar to the freshly prepared material.

It is not generally recognized that lead arsenate and calcium arsenate are fundamentaly different and that the conditions favorable for the

use of the one are unfavorable for the use of the other. Bordeaux mixture will have more influence on the toxicity of lead arsenate than of calcium arsenate.

The arsenic usually classed as water soluble may be in the form of a very soluble or a slightly soluble compound. It may even be colloidal. These differences are generally ignored but are important since they influence the amount of injury to the foliage.

The value of lime sulphur in the control of scale insects has recently been questioned. Certain chemical reactions produce calcium polysulphide while a different series of reactions result in its decomposition. By having conditions favorable for the formation of the polysulphide and unfavorable for its decomposition, good lime sulphur may be made without the use of heat. Under similar conditions the sulphur may be kept in the form of a polysuphide for longer periods of time than is possible with ordinary lime sulphur. May not such a preparation have greater insecticidal value?

Slight and what may appear trivial differences in the chemical constitution of the insecticide may cause decidedly different results. A potassium soap may be more injurious to foliage than a sodium soap altho made from the same oil and having the same alkalinity and the same water and glycerine content. How often do we see the recommendation of soap without any specification as to its composition?

In cattle dips the mere change from the arsenite to the arsenate is accompanied by a change in its insecticidal value altho the same amount of arsenic is still present in solution.

Even the arrangement of the groups in the molecule of an organic compound may make a great difference in its effects. M-nitro-p-toluidine is slightly more injurious to bean foliage than p-nitro-o-toluidine, but the latter compound is more toxic to *Epilachna borealis* Fab. Both of these chemicals have the same groups, differing only in the position of the radicals in the benzene ring.

Conclusion

These few problems picked at random from the field of insecticides will serve to show that the economic entomologist should be well grounded in chemistry. Having completed the general courses in physics and chemistry what further work should the student of economic entomology take in the limited time available for these subjects? It should be borne in mind that the object sought is, not the making of a chemist but rather, the production of an entomologist with sufficient

knowledge of chemistry to see and to be able to solve the chemical problems which confront him in the use of insecticides. Co-operation between the entomological and chemical departments of our universities should make it possible for the student of entomology to obtain such a knowledge without spending considerable time in courses essential to the chemist but not so necessary to the entomologist. Analytic chemistry is such a course. It is more essential for the entomologist to have a knowledge of organic and physical chemistry than to be able to make qualitative and quantitative chemical analyses. Among the organic chemicals there are doubtless many new and important insecticides awaiting discovery. Insecticides are applied in the form of emulsions, suspensions, and dusts, hence a knowledge of physical chemistry particularly that portion which treats "of bubbles, drops, grains, filaments, and films" generally known as colloid chemistry is most essential.

THE ENTOMOLOGIST AND THE PUBLIC

By W. C. O'Kane, *Durham, N. H.*

Abstract

Every entomologist comes into relation with the public. It is worth while recognizing this fact and turning it to good account. Bulletins, circulars and popular articles afford the widest contacts. Essentials for these are a ready command of vigorous English, a logical arrangement of material in bulletin or circular, the use of a summary, condensation and simplification of matter in popular publications, the use of readable type face, the employment of good illustrations, either photographs or line drawings, and attractive typography in general. Personal letters of inquiry should receive personal, direct answer. The county farm bureau and county agricultural agent can increase the value of the contacts and influence of the entomologist. Popular addresses, to be effective, require honest and adequate preparation. All of these things are worth while because they help to make the entomologist a useful servant of the public and a worthy representative of his science.

Every entomologist, at some point in his work, bears some relation to the public, whether that public be the wide and miscellaneous people at large, or whether it be a more limited group, specifically interested in his work. I can think of no exception to this rule.

Even the specialist, engaged in pure research, has occasion to make contacts, not only with other men engaged in the same science but with those who are interested only indirectly. He has letters to write, materials to discuss and papers to prepare. Not infrequently his reports are read by men who have no technical knowledge of his subject. He cannot, if he would, avoid these relationships.

For most of us contacts with broader groups are of daily occurrence and inevitable. We have a miscellaneous mass of correspondence to handle, publications to prepare for the layman as well as for the scientific reader, meetings to address, wherein the audience may know little about our subject matter. We are in contact daily with this or that person to whom our training and knowledge mean the opportunity to seek information or help. It is a characteristic of our profession, as it is of that of the physician. It carries with it an obligation that is at the same time a privilege.

The widest contacts made by the entomologist presumably are secured through the printed word: through bulletins, circulars and articles in the popular press. It should require no proof to demonstrate that for these contacts the first and vital essential is a definite, ready and workable command of English. Entomology is not alone in this requirement. It prevails, I am convinced, through all of the tasks that the college-bred man of today, whatever his calling, may undertake. Its possession is an equipment of definite, undeniable value which will facilitate his work, make it more effective and give him pleasure in its use. It is and should be fundamental in college courses. But its acquirement is not a matter of classroom alone. It is to be attained and strengthened only through diligent, thoughtful exercise, backed up by a lively interest and a sure appreciation of its worth.

You may say that this possession is unnecessary in the work of the man who is engaged solely in research. It is perhaps unnecessary in the sense that the given task of research may be carried on without it. But there could be no manner of doubt that with its help even the research specialist will strengthen at least some phase of his task.

I recall at the moment a technical bulletin that I read two or three years ago, describing the result of a long series of studies. It was a work of importance, broadly fundamental to the science of entomology and of interest not only to all who are engaged in that science but to the workers in other branches of biology, in chemistry and in physics. There was solid substance there. But it was so involved in the telling that its value was hidden rather than disclosed and its precise meaning made uncertain in some of its aspects. It was an excellent example of the unconscious art of obscuring valuable thought by valueless words.

In contrast my mind reverts to a brief paper read before our Association three or four years ago by one of the founders of Economic Entomology. The facts described in the paper were so clearly and so graphically expressed that one grasped them instantly and without

effort. This Association sat intent while the paper was read. The man who presented it has had a profound influence in the development of Entomology. A measurable part of that influence can be traced to the facility of expression which he trained his mind and his pen to follow. His books and his many printed papers bear witness, page by page, to the value of clear, vigorous English.

In emphasizing, thus, the worth of a command of English I would not be misunderstood as pleading for elaborate rhetoric or a familiarity with long words. Quite the contrary. Good English does not mean resounding phrases. It means only vigorous, direct, well-chosen expression, grammatically correct, of course, but above all clear and understandable. The documents in the English tongue that have stood longest and gone furthest have not been written in long sentences or many-syllabled words.

The arrangement of material in a bulletin or any other piece of printed matter is foundational. This is the framework on which the report is built. The skilful artisan plans his framework in advance of starting construction. He draws up his outline, determines what shall be the principal divisions of his report, what relation they shall bear to one another, what portion of the whole he shall devote to each. Then, and not till then, he sets about writing. Thus he produces a document that is logical in its structure, that begins at the beginning and ends at the ending, that gives you first the things that you should know first, and last the things that require prior knowledge for their understanding.

In any bulletin or report, except the very brief circular, a summary fills a well-marked need. Conceivably, it is difficult to condense into a summary of half a page or a page the many facts and records, exceptions and qualifications, surmises and conclusions, that go to make up the whole document. Nevertheless, a summary there should be, printed in a different style of type from the body of the document, in order that it may be quickly and readily laid hold of, and giving essentially the major conclusions of the paper.

Such a summary ought seldom to exceed one page in length. If it goes beyond that it tends to defeat its own purpose. It will be the more useful if each paragraph of it indicates the page number in the bulletin where the full discussion covered by that paragraph may be found.

The permissable length of a circular or popular bulletin, intended for the general public, is often exceeded. I am convinced that anything

beyond four pages is seldom read from beginning to end, unless the man who receives it is directly interested in that particular subject or has specifically asked for a copy of the document in question. In the field of motion pictures the willingness of the public to read printed words has long since been studied and determined. A title of a certain number of words is allowable, but a title of double that number is forbidden, even though there be plenty of room on the screen for another sentence or paragraph. The public will fail to read it all in the length of time available; and, having failed to read, will miss the significance of the scene that follows. So in a popular circular it is idle to disregard the willingness of the public to read. I seriously question whether a circular of four pages is actually read by a considerable percentage of those who receive it. Their time is short, or they think it is, which amounts to the same thing.

By a similar principle a type face that is too small repels rather than invites. Many circulars are printed in 7-point type and thereby fail to reach their readers, where 9-point or 10-point would invite attention. If the text is of such length that larger type face is impossible, the remedy lies in condensation of the text rather than resort to smaller type. Nine-tenths of the circulars that we write we can condense, if we are compelled to. Most of them would be improved in the process.

The importance of good illustrations is self-evident. This applies usually quite as much to the technical bulletin or report as to the popular circular, though, of course, the purpose of the illustrations and, therefore, their choice and treatment, may be quite different. Both the photographic print and the drawing should be utilized. Usually the purpose that is well served by the one is not so well promoted by the other. Both are needed. It follows from this that the entomologist should be trained in the making of drawings and in the taking of pictures. In his later work he may come to depend on others to perform both of these tasks for him. But he ought to know how they are done.

So far as the camera is concerned, it is likely that he will never wholly depend on others, for the reason that opportunity will arise to secure photographs of much value in his work if he habitually carries a camera with him and knows how to use it. In these days, efficient cameras are readily obtainable. The mechanical equipment is excellent. Plates and films are now made with wide latitude of exposure and with color values far better than those of a few years ago. Camera shutters are more accurate. In a word, the mechanical and physical equipment is far and away superior to that of ten years ago. The entomologist ought

to be able to use this knowledge and equipment and to make good photographs.

He does not always exhibit such knowledge. Every month circulars or bulletins appear carrying half-tone illustrations that show poorly timed negatives and a mediocre arrangement of subject. Backgrounds are muddy. Important features are out of focus or out of position. In contrast to these some of our entomologists are producing bulletins and reports that carry splendid illustrations, which amplify and illuminate the subject matter. Such bulletins are worth studying.

In spite of creditable material furnished by the entomologist, the printer may do his work so poorly that the effort of the entomologist to produce an effective publication comes to naught. If this is the case, it may easily be possible that the writer of a bulletin can tackle the problem by conference with the printer, by eliminating half-tones from text matter and substituting line drawings in such location, by confining photographic illustrations to an insert plate or two, and by similar methods.

Many entomologists receive large numbers of letters seeking information and advice. They constitute an important avenue of contact with the public. I am one of those who hold to it that a personal inquiry should have some sort of personal answer. It may be that the substance of the answer will be embodied in a circular mailed to the inquirer. But a typewritten and signed reply, even if only a line or two in length, is worth while, because it inevitably helps the man who wrote the inquiry to appreciate, to understand and to utilize the information that is sent him A printed form may convey all the essentials so far as necessary information is concerned. But to the average man such a form is inadequate and leaves with him a feeling that the entomologist to whom he wrote gave insufficient thought to his inquiry. The letter need not be long. Nor need it be the formal document that we are apt to make it. Let it be as if you were replying by word of mouth to a spoken inquiry, and you will carry your point the more readily.

Through the County Farm Bureaus and County Agricultural Agents, the entomologist may often increase the value and extent of his contacts and his influence. These county workers, with others who are engaged in extension activities, can serve important ends for many entomologists. They can assist in spreading information and in getting it utilized. Their direct contacts with farmers, fruit growers and gardeners can help the entomologist to a clearer comprehension of the

problems in his jurisdiction and thus serve as both a guide and a check in his investigational duties. Few men, except possibly certain research specialists, can afford to shut themselves up in a laboratory or can expect to maintain a broad and responsive viewpoint if they fail to seek contacts outside. And I am not sure that the specialist can afford isolation.

In the spoken word the entomologist has at his disposal the influence of direct appeal to a large group whose response he can influence. Those of us who have occasion to utilize this avenue will do well to give time and effort to adequate preparation.

I am reminded of the methods pursued by a close personal friend who speaks every week to two thousand or more people in Carnegie Hall, New York. This man is an able, convincing speaker, one of the best-known and most influential in our country. He is famous for the graphic directness of his address, for his ready choice of words, for ease, simplicity and the earnestness of his appeal. He speaks without any notes. Yet I happen to know that every address that he makes is prepared with assiduous care. The greater part of it is written out in longhand. The ready phrases are turned over and examined, studied and determined in advance. The address as you hear it from the platform represents prolonged and painstaking effort. There is not time to do this, you say. Well, this man, to whom I refer, carries a multitude of other duties, double or treble what you or I are accustomed to perform.

When an address is to be illustrated with lantern slides, I think that even more thorough preparation is necessary, if it is to move smoothly and without distraction. Personally, I know of only one way to accomplish this, and that is by writing it all out beforehand, arranging the slides so that they come smoothly in the proper place, without halting or indecision, and then either reading the paper as it has been written or so familiarizing oneself with it that its arrangement and the substance of it will remain in mind. By this I do not mean the committing of it, word for word. That may be both unnecessary and inadvisable. But I do mean that one should become thoroughly familiar with both the arrangement and the subject matter that is to be presented.

All of these things, the study of English, the thoughtful arrangement of material in bulletins and circulars, the preparation of good illustrations whether drawings or photographs, careful attention to makeup and printing, the willingness to answer personal letters with personal replies, the thorough preparation of material for addresses,—all of these things

mean serious effort and a minute attention to detail. But they will help to make the entomologist a useful servant of the public and a worthy representative of his science. And after all, to be a worthy scientist and at the same time a helpful servant is one of the durable satisfactions of life.

COURSES FOR THE POST-GRADUATE STUDENT OF ENTOMOLOGY

By E. D. Ball

Abstract

The ideal training for the future entomologist would be a broad and comprehensive undergraduate course with special emphasis on the fundamental sciences, followed by a year of specialized training in research, two or three years of assistantship under an inspiring leader, preferably a different one from that under which the graduate work was taken, and then enrollment in some other standard graduate institution for contact with another group of inspiring men, and the completion of his doctorate. The most important single factor in this program is the contact with the inspirational leader. The value of contact with such leadership is not limited to the educational period but is of continuing value throughout life.

The primary consideration of all training is to give the student the best possible equipment for his life work, and in this respect there is no measurable difference between undergraduate and graduate training. The difference lies rather in the objective sought.

In a broad generalization the under-graduate course could be called educational; the graduate work technical, but the fundamental difference is deeper than that and becoming increasingly important with the growth of the science.

The *first fundamental* of graduate training is breadth of knowledge and vision. The entomological field is becoming so broad and complex in its inter-relations with other sciences that it is impossible for a student to properly equip himself for satisfactory work in any phase within the confines of an undergraduate course.

The relationship of insects to human disease requires a knowledge of the broader aspects of the fields of preventative medicine, and sanitation. Their relationship to a large number of animal diseases broadens the field still further, while the rapidly developing relationship to plant diseases brings into greater prominence broader factors in plant physiology, pathology, and nutrition.

A broad knowledge of bacteriology, infection, and immunity is essential to any serious study of the control of insect-borne diseases on the

one hand, or the encouragement of insect-destroying diseases, on the other.

Any serious study of distribution or life histories involves factors of evolution and adaptation of both plants and animals, their ecological inter-relationships and probable trends of modification. This involves familiarity with the fundamentals of geology, soils, and climate, and their relative influence upon the complex under consideration.

The factors of attraction and repulsion in the ingredients of the various insecticides and fungicides used both direct and indirect, as brought out by Dr. Moore, call for a broad knowledge of chemistry, physics and physiology of both plants and animals.

The successful entomological worker of the future will therefore have an adequate undergraduate and post-graduate training, and that training will consist of introduction to the fundamentals of a large number of fields of knowledge, such as chemistry, physics, botany, zoology, physiology, geology, bacteriology, genetics, plant pathology, and entomology in the sciences, and economics, sociology, mathematics, history and languages in related fields, a knowledge of the fundamentals of nearly all the fields being more valuable than a more extended acquaintance with a smaller number.

The *second fundamental* in post-graduate work is to furnish adequate training in the methods of research. Theoretically this is the end sought; practically, it is more in the nature of a try-out to see if the individual possesses that almost intangible and indefinable something that makes for success in research. We owe it to our science to discover any tiny spark of that ability latent in the available material; watch over it, encourage it, and when found, fan it into a flame that will assist in dispelling the darkness of ignorance and in revealing the new pathways for human progress.

The *third essential* to graduate training, and in many respects the most important one, is to bring the student into contact with strong minds, men of inspiration, of vision, and of leadership. If we will consider for a minute the influence wielded on the future of science, through the inspiration of other workers, by a Pasteur or an Agassiz, or in more recent years by a Comstock, an Osborn, or a Fernald, we will thereafter in selecting courses for the graduate student, give more attention to the man than the subject. The inspiration, enthusiasm, and the point of view of a great man are worth far more than any relative merit of individual subjects.

In summarizing, there are three essentials to adequate graduate training:

(1) A broad knowledge of methods and fundamentals in many fields of human endeavor;
(2) A training in research; and
(3) Contact with men of inspiration and vision.

The ideal training would be to have an undergraduate course devoted almost entirely to laying a broad foundation. From a group of such students, those that show exceptional capacity could then be encouraged to take up the graduate work, the first year of which would be largely in training and testing of ability in research. If this proved satisfactory, encouragement should then be given to go on into still more extended endeavors in the research field and into contact with inspiring workers in other fields.

No one department can offer adequate graduate training. Graduate institutions are made up of many departments from which the student must select the best equipment for his chosen field.

Educational policy swings like that of a pendulum. In times past graduate training was considered to be little more than an increased amount of general education; then the pendulum swung the other way and it became too technical and specialized; in fact, the pendulum swung so far that specialization was carried to such an extent in the undergraduate courses as to almost ruin the student with a superficial specialization on a totally inadequate foundation.

We have as yet only partially recovered from this educational orgy; therefore in the present time, if a student who has carried specialization to extreme in the undergraduate course presents himself for graduate work, it is absolutely essential that the error be corrected, and that his graduate work largely make up for deficiencies in his breadth of training. With the best of efforts he can never be as well equipped as the one who took his broad training in the fundamentals first and brought that knowledge and breadth of viewpoint to his specialization, but he can be immeasurably helped.

The ideal training for the future entomologist would be a broad and comprehensive undergraduate course, a year of specialized training in research, two or three years of assistantship under an inspiring leader, preferably a different one from the one under which the graduate work was taken, and then enrollment in some other standard graduate institution for contact with another group of inspiring men and the completion of his doctorate. The major portion of the burden of his re-

search training will already have been completed. He will now be in position to appreciate breadth of vision and inspiration in other fields.

Above all things, let us not in our desire to build up large numbers in our own courses and in our own departments stand in the way of the proper breadth of equipment of the men on whom the future development of American entomology rests.

Research in entomology has developed so enormously that there is no possibility of any one worker covering the entire field of knowledge, or any reason why he should try. Every student should, for example, have some fundamental work in entomological classification and for many lines a rather detailed excursion into the classification of one or two orders will be beneficial, but unless trained to be a museum assistant, the mastery of the entire classification would be a burden rather than a help—an encyclopedia rather than a text. Even if the student was training to be a systematist, an excursion into systematic work in other orders of the animal kingdom, and especially into the modern concept of bacterial and fungoid relationships would be much more helpful. Half of the time otherwise spent in this work could be employed with more profit in the broad fields of evolution, genetics and ecology or in even more distant fields where contact could be made with inspiring men.

There is in my concept no possibility of laying out a postgraduate course for an individual unless you have first laid out the individual, that is, ascertained his aims, ambitions, and capacities. Stop for just a minute to consider the inspiration to zoölogical science of a man like Agassiz, not only in his generation but continuing down until the present to such an extent that today you can almost tell by listening to a man for a few minutes whether he was a student of Agassiz or even a student of one who was. The fundamental thing is to get inspiration into graduate work. Graduate training is not instruction, but inspiration,—training to think—to think clearly—and then, as Professor O'Kane suggests, he may be able to write clearly.

EXTRA-ENTOMOLOGICAL STUDIES FOR THE YOUNG ENTOMOLOGIST

By Vernon Kellogg, *Washington, D. C.*

Abstract

The more widely informed and the more soundly and broadly educated, the better the entomologist and the more effective he will be. The working economic entomologist should have some basic training in general zoology and botany, systematic

morphological and physiological. He should know something about chemistry. He should be able to read French and German. He should be able to speak and write good English.

General zoologists seem to pay little attention to insects. That is no reason why entomologists should pay no attention to general zoology. Insects are but animals and, considered even more broadly, but organisms. There are fundamental principles of biology that apply to all organisms, to all life. These fundamental principles should be known to entomologists. They can then be specially applied to insects.

Teachers of young entomologists should see that their students get all the general education they can compatible with the time needed for special training in entomology. Modern science, taking its cue from Pasteur, is breaking down the artificial barriers set up between such special fields as biology and chemistry, zoology and botany, zoology and entomology. A man may be a specialist in entomology, but yet not totally ignorant of other fields of science. Let us make our future entomologists broad and sound scientific men.

I want to thank you for giving me the last place this afternoon in this symposium because you leave to me the very simple function of gathering together and knotting the threads of discourse from the speakers that have preceded me.

You have had presented to you most of the important angles—probably you would have had all of them if Dr. Howard had replaced the absent Dr. Quaintance and if Dr. Riley had been here—from which the subject of our symposium could be approached. You have heard already of the major things that you need to have called to your attention specifically, so I have the function, as I have already suggested, of simply trying to point out the general significance of all of that we have heard.

That significance is as apparent to you as it is to me; it is, that we want and that we need soundly educated men and women to be teachers or students or workers in entomology. The more widely informed, the more broadly educated, the better the entomologist, and the more effective the entomologist will be.

I could have approached my discussion this afternoon with a little more confidence if there had not been keenly brought to me very recently, some of the consequences of my detachment from entomology in the last few years. The consequences of that detachment were brought clearly to my attention last night when speaking at a little gathering of the friends of Mrs. Comstock, the master of ceremonies, Dr. Weed, introduced me as that "late entomologist, Dr. Kellogg."

In the days when I was a live—or at least a living—entomologist, I received a letter from Dr. Howard, which made me very proud. I still remember that letter today. This letter contained a sentence

which read something like this: "We are glad to find here in the Bureau that the young men who come to us from your laboratory seem to have a sound scientific training." That was what I conducted the laboratory at Stanford for—to try to give sound scientific training to students in entomology.

I know I required my students, very often against their will, to take courses in general zoology and invertebrate zoology and embryology and general botany and plant pathology and mycology, and they had to do all these things before they could graduate from the department of entomology.

And it has been my good fortune in these late and declining years, or this period after my decease as an entomologist, to find that some of my students have stood up rather well as broadly educated and soundly grounded workers. That I believe is the goal we ought to try to reach by our education of young entomologists.

The extra-entomological studies that these men or women may take do not need definitions. They can be comprised in a general form by simply saying: Let us give them all the education that we can, compatible with the time which they should devote to their special undergraduate work in entomology. Their graduate work will go on, as long as they live; they will always be learning. We want them to learn in those extra-entomological studies or groups of studies to recognize that insects are but animals and finally, that animals are but living organisms, and that there are great principles and facts which concern all organisms. These the entomologist ought to know if he is going best to understand insects.

I have always been rather astonished and often grieved at the curious indisposition of general zoologists to pay attention to insects. Heaven knows, when they come to count up the animals that they have to do with, they will learn that the insects occupy, with regard to numbers, a major part of the great kingdom of animals. But over and over again, I have noted the courses in general zoology to be singularly deficient in reference to insects. If the course happens to be given in Kansas, they go in particularly strongly for the sea anemones and star fishes!

I remember that my teacher of zoology in the University of Kansas got leave of absence to go to the Pacific Coast, and there he ravaged the coast for miles and practically removed all the marine fauna from this coast, put it into barrels which he brought back, and for the rest of my college career I was pegging away on these pickled sea anemones. As a matter of fact Kansas had always ready for him and us plenty of insects to study, especially grasshoppers and chinch-bugs. But I will

also say that too many entomologists want to pay no attention to anything that is not a bug.

It is true that within the group of insects alone you can find brilliant examples illustrating all the major principles of evolution. Nowhere are there such striking examples of adaptations, variations, and those gradatory series of species that spell evolution to anyone who looks at them. All of these conditions of animal life are splendidly illustrated in insects. Perhaps influenced by twenty-five or thirty years of association with insects, I believe that more basic principles of evolution are beautifully illustrated among insects than in any other group of animals.

But I did not hesitate, especially in my undergraduate years and graduate years, to try always to realize that if I shut myself up alone with my insects I was going to miss knowing something about them that I could find out by looking elsewhere at other forms of life.

I got this first broadening glimpse when I went to work with Prof. Comstock, because he was using insects as illustrations of great principles of evolution. And then I got even perhaps a more broadening view of what one could do in the way of studying insects, when I went to the University of Leipzig and worked with famous old Professor Leuckart there. He was perhaps the greatest parasitologist that ever lived, and insects to him meant parasites; but there were so many insects that were parasites that he always, in his great courses of comparative anatomy and general zoology, gave insects their due place, although always in relation to the rest of animal life and even of plant life. And when one says plant life, that brings a suggestion with a special significance to this group of economic entomologists, because so much of your work is the attempt to save useful plants from injury by insects. And how are you going to do this soundly without knowing something about the habits and the anatomy and the growth and life history of these plants that you are trying to save? You are not going to do it simply by knowing the insects alone.

Mr. Moore has just called your attention to the advantages, aye, the necessity, of having, on your part, some knowledge of chemistry if you are to be effective economic entomologists. And that brings clearly to me just now something that was impressed on me two or three days ago when I helped to celebrate the Pasteur Centenary Celebration in Philadelphia.

Pasteur did the great things he did in biology because he also did great things in chemistry. We are not, most of us, going to be Pasteurs, but we can take a leaf from his book and analyze his method of work. He

was a man who paid no attention to these artificial distinctions that we set up among the different fields of science. He was celebrated almost equally as physicist, as chemist, as biologist, as a man of medicine, and a great contributor to animal and plant industry. He stepped through and across these artificial barriers. Not that he knew all of chemistry, nor all of physics, or all of biology, but he struggled to learn as much as he could of nature and of science, without regard to where this struggle led him, whether toward chemistry or biology or what not, in order to solve the problems in science that were proposed to him.

These problems were given to him, as your problems are given to you, by the conditions in the country in which he lived. The French had a great wine industry, and it was threatened with disaster; and so Pasteur went to work to try to save the wine industry, and in connection with that he made his world famous and lasting discovery of the causes of fermentation —the microbic causes.

When he finished that work, other countrymen of his called upon him to save another great French industry—the silk growing industry. Although he remonstrated that he had not touched a silk worm, and hardly knew one by sight, yet he did not hesitate, with his method and mind and good training, to attempt to discover the secrets of the diseases of the silk worm. And it was he who discovered the actual causes of pebrine, and devised effective remedies for this disease. He saved the French silk industry and that of the world.

Then he was called upon by the cattle and sheep growers, because their herds and flocks were being lost by *charbon*, or anthrax, and he studied the secrets of this and found that the bacillus of anthrax was the cause of the disease, and he also discovered that by attenuating a virus until it becomes a vaccine, and then inoculating the animals with this vaccine, he could immunize the animals from the effects of the disease.

Finally, Pasteur went on to the study of a human disease—that terrible disease of rabies—and he not only discovered its secrets and learned how to prevent its ravages but also founded the microbic doctrine of infectious human disease.

Well, there is an example for the entomologist. You and I can never be Pasteurs, but we can adopt his method and his broad point of view. We can encourage the kind of training that he felt he needed; we can urge our students to work broadly and not hesitate to go into new fields. He called himself first a physicist or chemist. We are entomologists, but is that going to restrain us from knowing zoology or botany or even some chemistry? I hope not.

And so my recommendation to you, based on an experience of twenty-five or thirty years in teaching entomology, is that we try to give our students the broadest education we can, in the time given us to work with them.

President J. G. Sanders: I want to thank each of the members who have taken part in this program. This might be called "the uplift session" of this meeting, and the keynote of Dr. Kellogg's talk has been "Courage."

We will now proceed with the discussion.

Mr. P. J. Parrott: I have enjoyed listening to the addresses very much, and desire, first of all, to express my appreciation to those who have had a part in this program. Then again, the paper entitled "The Employer's Viewpoint on an Entomologist" was not presented, and what I have to say bears largely on that subject. Now and then I lose an excellent worker from our staff, and it is sometimes very difficult to find one who will fill the place acceptably. The difficulty arises largely from the narrow training of the average entomological worker. Many of the men who apply for positions are trained to approach their problems from the avenues of insect morphology, life-history studies, taxonomy, etc. In order to make any substantial progress with our problems there is need of men with broader training, who have some knowledge of chemistry or plant physiology, or soil physics, and so forth, as has already been pointed out. There are certainly great opportunities for men with high ability who can attack specific tasks of a difficult character.

I am very glad that Mr. Moore pointed out the need of more training in chemistry. So many of our problems in New York relate to the control of insects by means of chemical substances. I think that a young student who shows some ability along chemical lines would do well to consider seriously the question of thorough training in chemistry. I need only point out the accomplishments in recent years with corrosive sublimate, paradichlorobenzene, contact dusts, etc., as indicating what triumphs we may expect in the future if men with technical ability would attack other similarly difficult problems of outstanding importance.

And then, from the standpoint of the effects of such accomplishments on our profession as a whole, you cannot ignore the fact that triumphs of this character must make a profound impression upon the public. We see that in New York with regard to the control of peach borer with paradichlorobenzene and root maggots with corrosive sublimate. There is created a most favorable impression when insects of that character,

which have been considered invulnerable, are finally demonstrated to be quite sensitive to treatment. Triumphs of that character must exert a tremendous influence on the public and should make it more easy to secure funds to attack other difficult problems.

So I would like to reiterate what has been said before, that entomology is, after all, not an independent science, and there is no reason why a man cannot be a chemist or a plant physiologist or an economist and still be an entomologist.

Mr. L. O. Howard: Mr. President, this subject was one of the subjects of discussion at the Conference of the Imperial Bureau of Entomologists in London, two years ago, and it is extremely interesting to make a comparison between the discussion that took place there and the discussion taking place here today.

In the first place, they had no speaker who had the experience and the authority of Dr. Osborn. They had no speaker who in his experience and in his force of presentation equalled Prof. O'Kane and Dr. Ball. They had no one who could compare with Dr. Kellogg, it goes without saying. Nevertheless, they had a most interesting discussion and they arrived at precisely the same conclusion that we are arriving at today, that the broader the training of the economic entomologist, the better it will be for economic entomology, and the entomologists themselves.

Some curious incidents connected with the discussion were these: In the first place, it was opened by Maxwell LeFroy, who, when he first returned from India, you will remember, read a lecture in South Kensington, on the training of an economic entomologist. It was a rather theoretical talk and it was interesting because he came to the same conclusion that we have reached. However, he said nothing whatever about the training of economic entomologists in America, where it has been carried much farther than in any other part of the world.

And after nearly every one had spoken there was a general call for Robert Newstead, of the Liverpool School of Tropical Medicine—a man of great accomplishment and high standing. He is a man, however, who had no technical training but was taken up as a promising young man by Eleanor Ormerod. He had educated himself, and it was interesting to see his reaction to this conclusion that we were gradually arriving at, and rather to our surprise, Newstead agreed with us and he said that of course the economic entomologist must have as broad an education as possible, Not having had a college training himself, he

might have overestimated the worth of the training, but he did believe that there should be the broadest possible training.

Mr. George A. Dean: I have listened with much interest and I must say also great profit to the splendid addresses that have been given on this important subject. But several times I have wondered how many of you have read the outline that was given by Dr. C. R. Mann of the Carnegie Foundation for the Advancement of Teaching in his Report of Progress in the Study of Engineering Education, which report was given a few years ago or at a time that several of the various engineering associations were considering the proper training of a man for engineering work.

I don't know that our work differs so much—in fact, in my mind it doesn't differ at all from the zoologist—or the chemist—or even the engineer. This outline has not been prepared by a psychologist. (I don't mean by this that I have no faith in psychology, for I certainly have). But it does seem to me that there are some things in this outline that are well worth considering, particularly when it has been prepared by some of the foremost engineers in this country, or by a group of men who have put across some of the greatest projects the world has known. With your permission I will write this outline on the board. Understand, in giving this outline I am not writing it as my outline, but as one that appeared in the Proceedings of the Society for the Promotion of Engineering Education.

The first is:			
PERSONAL QUALITIES—			
Character,	24%		
Judgment,	19½%		
Efficiency,	16½%		
Knowledge of men	15%	Total	75%
The second heading is:			
TECHNICAL EQUIPMENT—			
Knowledge of Fundamentals,	15%		
Technique,	10%	Total	25%
			100%

Now no one believes in a broad, fundamental training, more than I do, not only in science but in any other lines. But in the last analysis are we so much concerned with what a man knows, as what can he do with what he knows?

President J. G. Sanders: May we have a few words from Mr. Marlatt on the training of the young entomologist?

Mr. C. L. Marlatt: Your courage, Mr. President, I see, gives no signs of waning!

I should be only too glad to speak if I had anything to add to what has been said. I often think that the best compliment that can be given to a good presentation of a subject is—let it settle down, soak in, rather than to debate it.

I think this afternoon has been something of an exception. The discussion has added much of value. My belief is that the clearest presentation of the need is the analysis placed on the blackboard by Mr. Dean, and the important point brought out there is the 75% value placed on personal qualifications. The best qualities in most men are born in them; they may be improved and elaborated by training, but you have got to have them to begin with. You can't take a person who has not the fundamentals of character, and judgment—horse sense, we mean by that—willingness to work, and the achieving spirit, and put these qualities into him by education and training. He must have a grounding in those elements of character, born in him.

I would give a good deal more for that sort of a man than for one with technical education and lacking in these qualities. Such a man will get education and training, either in school or later in life.

Another thing of the greatest importance to the future of our profession is that the instructors in our Science in the schools and colleges shall have such standing and ability as to arouse interest, and attract to their subjects young men and young women possessing these higher qualifications. It is natural that other phases of human endeavor have attracted many of the better grade of men. There are greater rewards in other fields. But if you get the right kind of a professor, who will inspire enthusiasm, his students will get the viewpoint of adding to human knowledge, and get them somewhat away from the line of thought of the mere money reward. We will find I think that our best men trace back, as was brought out by several speakers, to the teachers in the schools, who attracted them—Agassiz, Osborn, Kellogg.

I remember discussing this same matter years ago with a man who has been prominent in zoological research work and who stands at the head of his line of work, and he said, "What I would like to do in getting assistants would be to look over the college graduates and pick out the men with those qualifications which are rated in the schedules at seventy-five per cent. I don't care whether they have any technical training in my line or not!"

President J. G. Sanders: If there is no further discussion, we will

take up the first question which is "How can the instructor maintain a vital interest on the part of students who are taking a beginning course in Economic Entomology as a required subject in agricultural courses, but who have no intention of specializing in Entomology?"

Mr. D. M. De Long: Those of us in agricultural colleges face this problem more than those who are training entomologists alone. The students come into the entomological course, which they are required to take as a part of the agricultural course, with an indifferent attitude. That must be overcome and you must get the student into a receptive attitude first.

Now that is accomplished easily by presenting to the student the importance of entomology, its importance in agriculture, and in showing, in addition to that, what is being done in the United States at the present time, in the big entomological problems. When you have finished stating these things to the student, he is in a state of mind to accept anything that you want to teach him in entomology.

Furthermore, if a man is going to take one term or one semester's work in entomology, is it wise to spend most of that time to give him details of antenna or leg structures, or is it better to take up economic entomology as such?

If one teaches economic entomology he must have an acquaintance with field problems, because you cannot teach only from a book. It is a subject that must be taught from field experience and observations, and the student must be taught to see the field problems so that when he goes back to the farm or takes up county agent work, he can face field problems as he finds them.

I feel, then, that in the beginning course in economic entomology we must sacrifice the first training that a man should perhaps have in entomology, in going ahead with his profession, for the ninety-eight per cent who are taking it, to benefit themselves in their general work in agriculture and later to give a man the special training that he needs in the field of entomology if he intends to follow it as a profession.

President J. G. Sanders: The next question is "How can students be helped to see the work of insects and their control under field conditions when the instructor has them only at a time of year when many important species are not active?"

This is one of the most serious problems that the instructor in economic entomology has to deal with in the northern institutions.

Mr. H. T. Fernald: Had I felt called upon to speak on the first question of the question box, I should have said that there was a phase

of psychology in it as a result of which a requirement to do a certain thing or a requirement not to do a certain thing is always provocative in the human mind, of a desire to do the other. Even a Constitutional amendment has failed to overcome that, as we have evidence.

Personally, after having had experience in teaching, both as a required subject and as an elective subject, the beginning entomology of a college course, I have reluctantly come to the opinion that in the long run all entomology in college should be elective. I realize that that involves certain undesirable features, but I am also of the belief that we gain in the long run more than we do by having all men required to take it. I will dismiss the first question with that answer.

As to the second question, I will frankly say I don't know. There are a few small things which can be done, and which I have done, with perhaps mediocre success. If I can carry the beginning students along to a point where I can bring in some egg clusters and have them hatch, before the students leave in the Spring, we can show them some of the changes which occur, and that is helpful. But when it comes to the vast number of our economic problems, which manifest themselves only during the summer months, the only solution I can see is in the form of summer courses. In some places these summer courses may be practicable but I am personally dealing quite largely with students who are obliged to put in a portion of the year in earning money with which to go on during the remainder of the year, and the summer months furnish them with that opportunity. It becomes therefore largely impracticable to require them to stay for summer courses; and while we have at the Massachusetts Agricultural College in theory a four term year or a four quarter year, the fourth quarter rarely has any subject offered in it, because of that reason, and I have not felt like pressing that matter.

I think the real way of getting at it under such difficulties, therefore, is to arouse such an interest in the subject, while you have the students, that they will be keeping their eyes open after they go out during the summer; and it is my experience, that many of them will come back in the fall, not with an understanding of what they have seen, but an intense curiosity to have explained what they did see. And if you have gotten curiosity aroused, that is the first step, at least, toward the development of interest and a desire to go on.

President J. G. Sanders: The third question is "How can the necessary laboratory work in the structure of insects, for example, be made definitely interesting to the average non-specializing student?"

Mr. C. L. Metcalf: I should very much prefer to listen, but I don't like to see these questions go by without more discussion.

In definite answer to this question, I should say that in my opinion the way to make the structure of insects interesting to a student is, first, to *make the active, living insect mean something to him.* The average student in college is interested in a subject in direct ratio to its answer to these three questions: What relation does it bear to his past experience; what obvious relation does it have to his anticipated future; and third, is it in itself directly interesting or attractive?

I think we shall have to admit, most of us, that the study of the structure of dead, more or less decomposed insects, is not in itself very interesting to the average non-specializing student of entomology. Therefore, we must make the most of the other points.

I have tried in the last three years in my teaching of beginning courses, the simple expedient of beginning the course in a way that hooks up, I think very nicely, the work of the course with the students' previous experience with insects.

No student who comes to college can have lived as much as five years in America, I think, without having had some definite vivid experience with some living insect. By the time he becomes of college age, he has had probably several such experiences.

The first period in my course I have therefore devoted to the simple and somewhat superficial diversion of making the students tell me *something that they already know about insects*, and I make them write it on the board. I shouldn't say "make," because they get into the game and a little rivalry soon results in a blackboard full of interesting things, ranging all the way from fights with bumble-bees to spraying for the codling moth. This little thing connects up the student's past experience with entomology, and makes him feel that entomology is not some form of discipline forced on him by a hard-hearted faculty, but a live subject dealing with a common and important phase of his environment.

In the second place, the relation to his anticipated future is something that can be taken up best by the method suggested by Dr. DeLong; by giving a comprehensive survey of the relation of insects to human welfare. In fact, much against the judgment of some of my colleagues, I have been turning the thing around, putting the cart before the horse, they think, in the beginning courses in entomology, by having the first course not a course in structure or classification of insects at all, but a course in the relation of insects to human welfare. In the first course in

entomology my students study insects of corn, of vegetable crops, insects of the household, insects of domestic animals and of the greenhouse and so on through the list of economic groupings, rather than to study them as Orthoptera, Coleoptera, Lepidoptera, etc.

In that way I feel convinced in my own mind that I reach the student in a way that gets up a momentum that will carry him through the following semester of more or less "dry" morphology and classification.

In other words, in my brief experience, I have been forced to this opinion somewhat against my will, that the way to get students interested in entomology is first, to *give them what they want*; and by that I mean, something that has a vital connection with their past experience and anticipated future; and after you have filled them so full of what they want that they can't hold any more of that, they will graciously and enthusiastically take what you want to give them.

Mr. R. N. Chapman: I realize that I am too young to say anything worth while, but I have been interested in this program and greatly impressed with the difficulty of educating myself. In the little teaching I have done, I have learned that there are some things that are hard to outline in a hard and set program of courses. I also believe that some of the qualifications on the board there apply to the instructor to a large extent and account for the success of his students to a considerable extent. If you were to look over America and see where our schools of entomology have been, I do not think you would be able to correlate them at all with the courses outlined, but you would correlate them directly with some great personalities.

Outside the field of entomology in a little college in the West, where the total number of students was only about two hundred, a teacher there in two years interested six people who are now known in the line of zoology.

We have about eight hundred students taking our general course now. The number who go on is not very great, but those who do go on can be correlated with the laboratory instructors they have. They are all getting the same laboratory outlines, but certain of those instructors inspire students to go on, while some of the others do not.

So I am afraid it is difficult to outline a course which would be applicable to everybody and could be taught with the same success by everybody.

President J. G. Sanders: Is there any further discussion?

I believe the benefit that has been derived from this symposium and discussion far outweighs what can be secured from a much longer program

of papers. The exchange of opinions on the part of the older and more experienced entomologists and teachers, is of great value.

A paper will now be given by Mr. L. A. Stearns.

SPREADER TESTS ON APPLES AND PEACHES[1]

By L. A. Stearns and W. S. Hough, *Virginia State Crop Pest Commission*

Abstract and Conclusions

Casein and Flour-Paste have received considerable attention for some time as spreaders and adhesives in spray solutions. In 1922, orchard tests were conducted with Kayso, a prepared casein spreader, and Magnet Dry Paste, a prepared flour-paste spreader to determine their effectiveness as influencing the spreading and adherence of the summer applications in the scheduled programs for apple and peach spraying in Virginia.

Neither of the spreaders used increased the effectiveness of the spray solution in protecting the fruit from insects and diseases. The same was true in case of the foliage. It is doubtful that the addition of a spreader, such as the two used, would pay for the increased cost of the spray. Nicotine Sulphate 40% (Black Leaf 40) and casein (Kayso), as used, were uncongenial.

The use of a spreader for sprays has developed recently from a recognized need of increasing the effectiveness of the spray solution. It has been demonstrated in the laboratory, but less certainly under orchard conditions, that certain materials possess specific characteristics which influence the spreading and adherence of sprays. Among these, casein and flour-paste have received considerable attention. Kayso, a prepared casein spreader, which has been widely advertized, and Magnet Dry Paste, apparently identical with the flour and billboard pastes, which have been recommended highly, are the two products used in the tests reported herein. The results represent one seasons' work only, and as such, are preliminary rather than final.

Tests With Casein and Flour-Paste Spreaders on Apples

These tests were conducted in Ophir Orchard at Leesburg and in the Kinzel Orchard at Winchester, the owners, Mr. L. Clark Hoge and Mrs. George Kinzel, cooperating. Both are hillside orchards. Ophir Orchard contains 12-year old Staymans interplanted with Yellow Transparents and Jonothans in contoured rows, while the Kinzel Orchard is a solid block of 21-year old Yorks.

The Virginia spray calendar for apples, in 1922, called for 5 quarts of standard lime-sulphur and 1 pound of powdered lead arsenate to 50

[1]The tests at Leesburg and Vienna were conducted by the senior author, and at Winchester, by the junior author.

gallons of water to be applied: (1) when the cluster buds are pink, (2) when the petals are falling, (3) two weeks after petal fall and Bordeaux mixture, the 4-5-50 formula, and 1 pound of powdered lead arsenate to 50 gallons of the solution, (4) four weeks after petal fall and (5) ten weeks after petal fall.

The experiment was planned to include four tests, all varieties occurring in each. Test or Plot 1 was to receive all summer applications as scheduled without a spreader; plot 2, a casein spreader in the "two weeks" application; plot 3, a casein spreader in all applications; plot 4, a flour-paste spreader in all applications. Casein (Kayso)[2] was used at the recommended rate of 1-½ pounds, and flour-paste (Magnet Dry Paste)[3], 3 pounds to 200 gallons of spray solution.

The spray outfit at Ophir Orchard was a 200 gallon Friend equipped with two rods bearing four nozzles each, and a pressure averaging better than 200 pounds was maintained in all applications. In the Kinzel Orchard, a Hardy "Big Three" equipped with two single-nozzle guns was used; the pressure maintained varied from 250 to 300 pounds. In both cases, one lead was operated from the tower and the other on the ground. The spray materials were mixed by the writers, and the applications made by the regular orchard force under their supervision.

At picking time, each variety was graded separately, and the results tabulated. The variation in the amounts of injury in the several plots within varieties was found to be so uniform that the complete results have been summarized by plots in Table 1.

TABLE 1—RESULTS OF TESTS WITH CASEIN AND FLOUR-PASTE SPREADERS ON APPLES, VIRGINIA, 1922

Type of Injury	Plot 1 10,421 Apples		Plot 2 10,949 Apples		Plot 3 12,680 Apples		Plot 4 11,134 Apples	
	Regular Treatment No Spreader		Casein Spreader in One Application Only		Casein Spreader in All Applications		Flour-Paste Spreader in All Applications	
	No.	%	No.	%	No.	%	No.	%
Codling Moth	12	.12	109	.99	51	.40	37	.33
Leaf Roller, Bud Moth	100	.96	293	2.67	270	2.13	167	1.49
Curculio	614	5.89	351	3.20	312	2.46	279	2.50
Scab	811	7.78	1349	12.32	1266	9.98	1255	11.27
Black Rot Bitter Rot	269	2.58	489	4.46	242	1.90	310	2.78
Spray Burn	51	.49	5	.04	23	.18	24	.21
Plot Averages		2.97		3.94		2.84		3.09

It is apparent from the results in Table 1 that as far as insect and disease injury is concerned the spray without a spreader gave equally as

[2]Kayso—California Central Creameries, 277 Broadway, New York City.

[3]Magnet Dry Paste—Penn Paste Milling Co., Wilkes-Barre, Pa.

efficient protection to the fruit as the spray with either of the spreaders added. There is no appreciable difference in the relative amount of injury in the several plots.

Foliage Observations. The suggestion has been made that some spreaders, on account of their protein content, might provide a medium in the spray solution in which disease spores could germinate. An examination of 3,000 leaves selected at random, 1,000 from each of the three plots of the York Imperial variety, failed to show that this actually occurred to any extent. In the case of *Rust*, (*Gymnosporangium juniperi-virginianae*), the percent of infested leaves was as follows: no spreader, 22.5 percent; casein, 22.6 percent; flour-paste, 22.7 percent; again, in the case of *Frogeye*, (*Physalospora cydoniae*),: no spreader, 2.1 percent; casein, 1.9 percent; flour-paste, 1.0 percent. It is impossible to conclude, therefore, that the addition of the spreaders either increased or decreased the fungicidal value of the spray with respect to the fungi on the foliage.

The general condition of the foliage in all plots and on all varieties revealed nothing in favor of the use of either spreader. Of course, the dried spray material was more apparent where casein and flour-paste were used, but the more conspicuous and apparently more uniform spray covering failed to provide a better protection for the foliage.

Tests with Casein Spreader on Peaches

The information in this particular is incident to the Oriental Fruit Moth project of the Crop Pest Commission. Spraying operations in the experimental control of this insect in 1922 were conducted in the Chilcott Orchard at Vienna. This is a young apple orchard interplanted with peaches of the Carman, Hiley, Belle and Elberta varieties, of which 1,600 are now in bearing.

The regular summer treatment given in this orchard is as follows: (1) 2 to 8 days after petal fall, 4 pounds of powdered lead arsenate and 16 pounds of hydrated lime to 200 gallons of water; (2) 3 weeks after 1, the same again with 20 pounds of atomic sulphur added; (3) one month before fruit ripens, 20 pounds of atomic sulphur to 200 gallons of water.

In this experiment, four of the test plots in which all varieties were represented gave results pertinent to the effectiveness of casein as a spreader. Test or Plot 1 received the regular treatment without a spreader; plot 2, a casein spreader in all applications; plot 3, nicotine sulphate 40% in all applications; plot 4, nicotine sulphate 40% and

casein in all applications. Nicotine Sulphate 40% (Black Leaf 40) was used at the 1 to 800 dilution and casein (Kayso) at the recommended rate of 1-½ pounds to 200 gallons of the spray solution.

The spray outfit used was a 200 gallon Friend, equipped with two single-nozzle guns; the pressure maintained was slightly less than 200 pounds. The materials were mixed, and the applications made, by Chilcott Brothers.

When the peaches were picked, they were graded and results tabulated by varieties. As in the case of the apples, the variety variations were so slight that the results have been combined by plots in Table 2.

TABLE 2.—RESULTS OF TESTS WITH CASEIN SPREADER ON PEACHES, VIRGINIA, 1922

Type Of Injury	Plot 1 57,698 Peaches		Plot 2 49,753 Peaches		Plot 3 47,634 Peaches		Plot 4 97,821 Peaches	
	Regular Treatment No Spreader		Regular Treatment With Casein Spreader		Regular Treatment With Nicotine Sulphate 40%		Regular Treatment With Nicotine Sulphate 40% and Casein Spreader	
	No.	%	No.	%	No.	%	No.	%
Curculio	2680	4.64	1927	3.87	2874	6.03	4143	4.23
Brown Rot	189	.32	87	.17	91	.19	795	.81
Scab	16	.03	15	.03	60	.12	70	.07
Spray Burn	192	.33	69	.14	309	.64	185	.18
Plot Averages		1.33		1.05		1.75		1.32

The results on peaches in Table 2 parallel the results on apples in Table 1. Here again, the spray without a spreader gave equally as efficient protection to the fruit as the spray with a spreader added.

PRESIDENT J. G. SANDERS: The next paper is by Mr. R. H. Smith.

SPREADERS IN RELATION TO THEORY AND PRACTICE IN SPRAYING[1]

By RALPH H. SMITH, *San Francisco, California*

ABSTRACT

Fog spraying works out poorly. Much can be said for high power spraying. Spreaders give a uniform covering with low pressures. Substances with very low surface tensions, such as saponin and soaps give too thin coatings, caseinate a thicker film deposit without affecting compatiblity. Wind and rain doubtless affect efficiency. A suitable spreader, such as calcium caseinate, increases efficiency, as shown by tests with the codling moth, *Carpocapsa pomonella*, green apple aphis, *Aphis pomi* and woolly apple aphis, *Eriosoma lanigera*.

The tendency of sprays to collect in drops on smooth surfaces and the action of rain and wind in removing spray materials after they have

[1]Contribution from the Research Laboratories of California Central Creameries.

once dried, are factors which doubtless have an important bearing on the efficacy of spraying in controlling insect and fungous enemies of plants. Spray spreaders and adhesives have been studied and used in a limited way in various countries, but they have not come prominently to the attention of students of pest control in America until the past two or three years. Efforts to increase spraying efficiency have been directed chiefly toward the improvement of spray machinery and equipment rather than toward improvement of the physical properties of spray solutions and mixtures. In order to secure a more even distribution of spray material as well as to get a more complete coverage on fruit and foliage, a great deal of emphasis has been placed upon the use of high powered sprayers and the mist or fog type of spray.

The "fog theory" of spraying requires that the spray carry out a short distance from the nozzle, then break into very fine mist particles which, like the particles of moisture in a fog, would suspend in the atmosphere and come to rest so thickly and evenly on the surface of an apple, for example, that the result would be tantamount to an unbroken film of spray. Much may be said in favor of high-powered sprayers but fog spraying, on the whole, works out very poorly in actual practice. Probably not less than seventy-five per cent of spraying, the country over, is done with sprayers which do not give sufficient pressure for effective fog spraying. Furthermore, the technique of ideal fog spraying is exacting and requires decidedly more thoughtful manipulations than the average sprayman will give. Finally, satisfactory fog spraying is very difficult, if not impossible, where any considerable wind may be blowing. Even under optimum conditions one finds that in order to reach all parts of the tree some parts will become oversprayed, with the result that the spray collects in drops, leaving the surfaces unevenly covered and less effectively protected.

The film spray, such as is obtained by use of a spreader, is well applicable to practical spraying conditions. Spreader enables one to secure the same uniform covering of spray with low pressure as with high pressure sprayers, although it should be stated that high pressure, giving a fine, driving mist, is most efficient and economical. By using a suitable spreader and spraying equipment that is reasonably efficient, it is within the bounds of practicability for the orchardist to effect a fairly uniform, continuous and complete covering of spray material over the fruit, leaves or bark of his trees. Contrary to popular conception, spreaders do not cause the spray to spread or creep, at least to any material extent, from the sprayed side of an apple, for example, to

the opposite side, that has not been sprayed. With calcium caseinate, especially, the spreading occurs at the instant the spray strikes and there is no secondary spreading; hence, in order to get complete coverage, it is necessary to spray a tree at least from opposite sides, if not from a number of different positions, the same as ordinarily is done. The introduction of a spreader also affords opportunity to accomplish other desirable improvements in the physical and chemical composition of spray mixtures and solutions, which in themselves are of much importance.

The writer is not prepared to undertake at this time an extended discussion of the qualities and merits of the numerous substances that have been tested as spreaders; therefore, only certain phases of the subject are here considered. The thickness of the film-deposit, or the dry material that remains after the liquid film evaporates, is of much importance in choosing a spreader. In case of dormant spraying, for example, it usually is desirable to effect a comparatively thick coating of material on the bark, and the same applies, though perhaps in a more general way, to fruit and foliage sprays. Substances having very low surface tensions, such as saponin and soaps, are efficient in producing spreading and film formation, but the resultant film-deposit of spray material is so thin, at least in case of arsenate of lead, that there may be doubt as to its efficiency in giving protection to the sprayed surface. Caseinate gives a thicker and more durable film-deposit than do the above substances. Calcium caseinate possesses certain qualities not well understood, which cause a rapid fixation of the liquid film, and this gives promise that within certain limits we may be able to govern, according to various requirements, the thickness of the film-deposit.

Compatibility with the various standard and proprietary insecticides and fungicides, as well as with spray waters of varying alkalinity, is a qualification that alone is sufficient to eliminate a number of spreaders that have been tried. Soaps, such as commonly are used with nicotine sprays, show a marked tendency to produce flocculation, precipitation and insoluble soaps, which deleteriously affect the physical and chemical composition of spray solutions and mixtures. These substances, and also sodium caseinate (casein dissolved with sodium hydroxide), when used with arsenical spray mixtures, tend to increase the amount of soluble arsenic in arsenical compounds and to lessen the stability of combined sprays. Calcium caseinate appears to exhibit none of these defects, so far as we have been able to determine at the present time. Miscible oils are good spreaders and possess some additional qualities

which commend their use especially with dormant sprays, but incompatibility with sulfur and bordeaux compounds, as well as with arsenicals, is an important barrier to their practical use.

Although further experimental evidence is needed on the point, there can be no doubt that rain and wind exert a great influence in reducing the efficiency of sprays. By combining suitable adhesive qualities in the spreader, it is possible not only to overcome to a considerable extent the deleterious effects of rain and wind in removing the spray material, but also, by lengthening in this manner the period over which a spray application will give protection, to reduce the number of applications necessary to control certain pests. Hence, the adhesive qualities of a spreader becomes of much importance. The casein type of spreader has shown superior adhesiveness in comparison with saponin, soaps, oils and gum arabic.

A consideration of the more important factors involved leaves little room for doubt that a suitable spreader is efficacious in giving increased control of those insect and fungous pests which in general are amenable to the spraying method of control. However, adequate orchard, field and garden spraying experiments to determine this point with accuracy, have not yet been consummated. Carefully conducted orchard and insectary tests, made by the writer in Idaho during the years of 1920 and 1921, gave results which indicated very positively that calcium caseinate, used with arsenate of lead, is capable of giving improved control of codling moth. These tests also showed clearly that the addition of calcium caseinate to the combined spray of arsenate of lead and nicotine sulfate, gave much better control of green apple aphis (*Aphis pomi* DeG.) and woolly apple aphis (*Eriosoma lanigera* Hausm.) than did the same spray materials when used without the spreader. Furthermore, the experiments indicated that with the spreader, apparently due to its adhesive qualities, it would be possible under Idaho conditions to omit the second cover spray for codling moth without impairing the effectiveness of control.

The rather general use of a commercial calcium caseinate spreader during the past year in practically every fruit growing section of America, shows with reasonable conclusiveness, if we assume that the orchardist himself is capable of judging correctly that this type of spreader possesses decided merit in increasing spraying efficiency and giving improved control of various pests for which sprays are applied.

Mr. G. E. Sanders: I would like to ask whether increased burning results from calcium caseinate in combination with straight arsenate of lead.

Mr. R. H. Smith: That has never occurred in actual orchard spraying. The charts that Mr. Stearns showed indicate that calcium caseinate decreased burning. We have run 46 samples and in each case the calcium caseinate decreased burning.

Mr. G. E. Sanders: That is arsenate of lead combined only with calcium caseinate?

Mr. R. H. Smith: Yes.

Mr. B. A. Porter: We have used plain arsenate of lead with calcium caseinate in Connecticut and there was no burning.

Mr. W. P. Flint: The difference was only 1 or 2 per cent in Illinois and in some cases the percentage of worms in the lot sprayed where the spreader was used, was greater than where it was not used.

Mr. G. E. Sanders: I want to say that from an analytical standpoint the relation of calcium caseinate to lead arsenate should give increased burning; because when we had Mr. Kelsall at the laboratory we did careful work on the addition of varying quantities of lime to lead arsenate and where he used less than ten per cent by weight of lime with lead arsenate he increased the amount of soluble arsenic greatly, and where the amount of lime was more than ten per cent, there was a decrease in the amount of soluble arsenic; so that with the small amount of lime that there is in calcium arsenate, I would expect to get quite an increase in the amount of burning.

Mr. William Moore: I would like to say a word about the reactions of lime and lead arsenate and calcium caseinate and lead arsenate, and what we define as soluble arsenic and arsenic that will cause burning.

It is true that if you add lime to lead arsenate that the amount of soluble arsenate increases. It has also been demontsrated, I believe, for a number of years, that the use of lime with lead arsenate will usually reduce burning. When lead arsenate is in contact with water, a reaction occurs which produces a certain amount of soluble arsenic, which soluble arsenic is in the form of arsenic acid. When you add lime it is no longer arsenic acid, but calcium arsenate.

Now the solubility of the arsenic compounds present in solution may have a bearing on the degree of burning. In other words, you can have two solutions with identically the same amount of soluble arsenic, one in the form of calcium arsenate and the other in the form of arsenic acid. These two solutions may give entirely different results on foliage. An

excess of lime suppresses the ionization of the calcium arsenate. The small amount of calcium in the calcium caseinate will produce a small amount of calcium arsenate, but there will not be sufficient to suppress the ionization of the calcium arsenate formed. The addition of further lime will reduce the soluble arsenate.

President J. G. Sanders: Is there not considerable difference in the quality of the water used in different parts of the country?

Mr. William Moore: A big difference.

In the South you would have another factor due to an alkaline water, which reacts with lead arsenate. The presence of sodium carbonate will produce sodium arsenate which probably gives different results from either the arsenic acid or the calcium arsenate.

Mr. P. J. Parrott: At present in New York State the matter of stickers is of great interest, and one of the problems of the economic entomologists is to advise the growers wisely. There is considerable difference of opinion as to their value.

Mr. W. S. Regan: During the past season we used several hundred pounds of calcium caseinate spreader in connection with our arsenical sprays against the fruit tree leaf-roller, in the orchards of the Bitter Root Valley, Montana. We found that this spreader added materially to the efficiency of the arsenical sprays. In fact, with six to eight pounds of arsenate of lead, to the two hundred gallon tank, and one to two pounds of the caseinate spreader, we were able to obtain a kill of approximately ninety per cent of the caterpillars, when application was made at the calyx period, immediately after the falling of the blossoms. Also the addition of the caseinate spreader, when arsenate of lead and lime sulphur are combined, prevents the decomposition and formation of black sludge, which results when the spreader is not added. One to two pounds of spreader is more effective in preventing the decomposition than ten pounds of hydrated lime.

Mr. William Moore: I would like to bring up another question while on this subject and leave it to you to think about. A few months ago I was going through the Edgewood Arsenal and I was very much surprised to see the amount of bottled milk standing about. Dr. Cook was with us at the time and being curious asked, "Why do the people drink so much milk here?" The answer was that the workers with arsenic compounds found that the use of milk aided in the elimination of arsenic.

President J. G. Sanders: The question of stickers is comparatively new and it seems to me that more information is needed from various

parts of the country where different conditions exist in order to obtain definite information.

The next paper is by W. E. Britton.

RAPID SPREAD OF THE APPLE AND THORN SKELETONIZER, *HEMEROPHILA PARIANA* CLERCK

By W. E. Britton, *State Entomologist, New Haven, Conn.*

Abstract

This European insect, *Hemerophila pariana* Clerck, first appeared in the United States in Westchester County, N. Y., in 1917 and in Greenwich and Stamford, Conn., in November, 1920. In 1921, first brood injury was prominent and adults were abundant in Greenwich and Stamford and before the close of the season records indicated that this insect occurred in all counties of Connecticut except Windham County. Late in 1922, unsprayed apple trees were brown from its attacks in the vicinity of New Haven and northward through Hartford. It was also observed in Windham County, Conn., and in Huntington and Amherst, Mass. Adult moths were very abundant on window screens in late fall and it is believed that it passes the winter in the adult stage, and that it spreads chiefly by adults moving with the prevailing winds. Dr. Felt reports an invasion just south of Albany, N. Y. It is believed to be in northern New Jersey, though definite proof is not at hand.

This insect was first discovered in Westchester County, N. Y., during the summer of 1917, and was apparently an accidental introduction, perhaps from Europe. The center of the infestation was at Irvington, Westchester County, but it was soon found across the river in Rockland County. Dr. E. P. Felt early published a brief note[1] calling attention to the presence of the pest, and later gave in a bulletin[2] and also in one of his reports[3] fairly complete accounts of the insect. He warned me to watch for it in Connecticut as the infestation was only a few miles from the Connecticut border.

It was not until November 1920 that the insect was noticed to be present in Connecticut, first at Belle Haven, in the town of Greenwich, where its injury was the most conspicuous, but later in Stamford where a small amount of injury occurred here and there. Both of these towns are situated in the extreme southwest corner of Fairfield County, and of the State. A brief account of this insect based upon Dr. Felt's publications, and recording its occurrence in Connecticut was published[4] in my twentieth report as State Entomologist.

The following summer, 1921, reports indicated that the injury caused

[1]Journal of Economic Entomology, x, 502, October 1917.

[2]Cornell Extension Bulletin, No. 27.

[3]Thirty-third Report N. Y. State Entomologist, 33, 1917.

[4]Report Connecticut Agricultural Experiment Station, 190, 1920.

by the first brood larave was rather prominent and on June 24 I visited Greenwich and Stamford, and crossed the State line into Port Chester, N. Y. Some apple trees in Greenwich, but many more in Port Chester, had been skeletonized, and the foliage was entirely brown. This had been done by the first generation larvae which had matured, pupated, and many adults had emerged by June 24. When disturbed, the little purplish brown moths flew out of these trees in swarms, and they were common, resting upon the daisies and other flowers about the field. During the season of 1921, this insect and its work was sent to the Station from many different points within the State, and Station entomologists observed it at other places, so that by the end of the season we had records of it from all counties except Windham County in the northeast corner of the State. This seemingly rapid spread was noted in the Station Report for the year.[5]

During 1922, the insect was very abundant about New Haven, particularly late in the season. Nearly all unsprayed apple trees were brown. The writer observed this condition in New Haven, Orange, Woodbridge, Milford, Hamden, Cheshire and along the automobile thoroughfare between New Haven and Springfield. Many inquiries about it were received at the Station and many specimens were submitted for identification. One of the Assistant Entomologists observed the insect in Windham County, so that now we know that it occurs all over the State.

In New York State, according to Dr. Felt, a rather serious infestation of this insect was discovered the past summer in the southern part of Albany County, near Albany, and at present the insect occupies a strip along the Hudson River valley but not extending more than four or five miles on either side from the River. It is believed to be present in northern New Jersey but no very definite records are at hand.

During August the writer examined a number of apple trees and hawthorn bushes in the vicinity of Pittsfield, Mass., without finding any traces of the insect. Dr. B. A. Porter, however, later observed it at Huntington and Amherst, Mass. At Amherst, late in the fall, the adults were quite abundant, and as the infested trees observed would hardly produce them in such numbers, it has been suggested that they migrated northward from Connecticut, where they were very abundant in September, October and November; even a few have been observed since

[5] *Ibid.*, 186, 1921.

December first. These adults were found resting upon window screens all through the fall months. Frequently we have counted as many as fifteen adults on a single screen covering half of the window of the Entomological Laboratory at the Station. Dr. Porter reports that he counted thirty on one screen at Wallingford, Conn.

From the available life history data, published and unpublished, it is apparent that the winter is passed by this insect in the adult stage, though possibly an occasional pupa may live through the winter. It is also evident that the spread of the species takes place chiefly by the adults emerging in abundance and moving in the direction of the prevailing winds.

Mr. S. W. Frost: I am especially interested in this pest and in the way it has migrated to the East. I have been on the watch for this pest but have not seen anything of it to date in the southern part of Pennsylvania. In the northern part of the state I have not traveled so much and have not been able to make many observations.

I might say that I have seen outbreaks along the Hudson River and it is rather a striking pest—green with relatively large black spots and it would be very difficult to overlook it. I feel very certain that the pest has not occurred in Pennsylvania and I would be interested to know if anyone has found it in New Jersey or in the northern part of Pennsylvania.

Mr. W. E. Britton: Dr. Felt has told me that this insect occurs in the Hudson Valley as far north as Albany, but apparently has spread only four or five miles each side of the river. The sprayed orchards were not injured.

President J. G. Sanders: The next paper is by Mr. W. P. Flint.

SHALL WE CHANGE OUR RECOMMENDATIONS FOR SAN JOSE SCALE CONTROL

By W. P. Flint, *Urbana, Ill.*

Abstract

During the years of 1920 to 1922 inclusive, the San Jose Scale, *Aspidiotus perniciosus*, has increased very rapidly in southern Illinois and neighboring states. In southern Illinois it has resulted in the loss of over one thousand acres of commercial orchard annually treated with lime sulphur.

Experimental work was carried out in the spring of 1922 with miscible oil and lubricating oil emulsion, similar to those used by the Federal Bureau of Entomology in Florida. The lubricating oil emulsion gave nearly as good control of the scale as did the miscible oil and a much higher degree of control than was obtained from

the best grades of liquid lime sulphur. As a result of this work the lubricating oil will be generally used in southern Illinois during the coming year.

During the past three seasons orchards in southern Illinois have been severely damaged by San Jose Scale. This damage extends over the corresponding orchard districts in neighboring states in the Mississippi Valley, but does not reach north of the 40th degree of north latitude in Illinois. More than one thousand acres of commercial orchard in Illinois alone have been killed in the last two years, and severe losses to fruit have also resulted.

There are more than 40 thousand acres of orchard in southern Illinois. While a number of these are far from being well sprayed there are many growers who make every attempt to keep their orchards free from insects and disease, using up to date equipment and following the method of control advocated by state and federal authorities. A number of these men are University graduates, and are thoroly familiar with the theoretical as well as the practical side of spraying. These men have suffered nearly as heavily as have the poorer class of orchardists. In fact, at the present time there is not one grower in fifty in southern Illinois who feels satisfied with lime sulphur for controlling the San Jose Scale. Whatever the Entomologist may think, it is practically useless to advise these men to continue spraying with lime sulphur, although we have a few cases where severe San Jose Scale infestation has been cleaned up by thoro applications during the past two years, using commercial liquid lime sulphur.

Owing to the above conditions a series of experiments, under the direct charge of Mr. S. C. Chandler, was started at Olney Illinois in the spring of 1922. In these experiments commercial lime sulphur was compared with Spramulsion, Pratt's Scalecide, Diamond paraffin oil emulsion, Soluble sulphur and dry lime sulphur. The trees selected for the experimental work were twenty-five year old Ben Davis and Grimes Golden, in a large commercial orchard which had been sprayed with lime sulphur for the past ten seasons and which was at the time of the experiments very heavily infested with scale, about thirty acres in one part of the orchard having been killed by the scale. The experimental plots were five trees long by four trees wide and the results of the treatment were taken from the center trees in the block. The trees were sprayed on March 28th and April 4th with the wind from the south on the first day and from the north on the last. As thoro covering of the trees as possible was made on both days. From twenty to twenty-two gallons of material was used per tree.

On May 17th, forty-three days after the last application was made, a number of small branches were taken from the tops, center and lower parts of the two trees in the center of each of the spray plots and examinations of living and dead scale were made individually by Mr. J. J. Davis, Mr. P. A. Glenn and the writer, none of whom knew the treatment which had been given to the scale which they were examining. The average of these examinations is as follows:

Treatment	Percent of Living Scale 47 Days after Treatment
Scalecide (1 to 15)	Less than .5%
Spra-mulsion (1 to 15)	.4%
Diamond paraffin fish oil soap emulsion (2%)	1.5%
Junior Red Engine fish oil soap emulsion (2%)	7. %
Commercial liquid lime sulphur (32° Beaume, 1 to 8)	11. %
Soluble Sulphur, Niagara (15 lb. to 50 gals. water)	18.5%
Dry lime sulphur (15 to 50)	41. %
Check, no treatment	50.4%

The remainder of the orchard was thoroly sprayed in the fall of 1921 with steam cooked lime sulphur at a dilution equivalent to one to seven, from the 32° Beaume concentrated solution, and again in the spring with the same material. By October 1st, 1922 most of the trees were incrusted with San Jose Scale, and few apples could be found in the entire orchard that were not badly specked with the scale. Many of the growers in this section have had the same experience.

If with the thoro spraying given in our experimental plots eleven percent of the scale remained alive after the application of dormant spray, it is evident that a more effective material must be used if such can be found which will meet the requirements of orchardists as to availability, freedom from injury to the trees and cost.

Many orchardists in the southern Illinois section have used commercial miscible oils during the past season and on the whole have obtained much better control of the scale than has been the case with lime sulphur. On large trees where from fifteen to twenty gallons of the dilute spray are required to a tree, the cost of the miscible oils makes them almost prohibitive. The homemade lubricating oil emulsions which have been used for a number years by Mr. W. W. Yothers in Florida for controlling citrus insects and which were included in our experiments and have given nearly as good control of the scale as has been the case with commercial miscible oils, at a cost considerably lower than that of the liquid lime sulphur. At the present price commercial liquid lime sulphur for the dilute spray ready to apply to the tree will

cost from 1¾c to 2c per gallon, commercial miscible oils figured on the same basis will cost from 4½c to 5c per gallon and the home made lubricating oil emulsion from ¾ to 1c per gallon.

During the past year several thousand gallons of this lubricating oil emulsion has been applied to southern Illinois orchards, in every case with highly satisfactory results so far as control of the scale was concerned, and in no case resulted in any injury to the trees.

The Federal Entomologists working with these sprays during the past season in Arkansas have obtained similar results to those here reported from Illinois. There is hardly a commercial orchardist in the southern part of the state who does not plan to give at least a part of his orchard a dormant treatment with these sprays. In view of the fact that our work with these sprays covers only one season we are not recommending them.

Under conditions where the orchardists have become dissatisfied with lime sulphur, and where experimental work has shown only a fair degree of control with this material, is it not advisable to recommend the use of the oil sprays, at least until the scale is again brought under control?

Mr. W. J. Schoene: Will Mr. Flint tell us how he makes the mixtures and what strengths he uses in the sprays?

Mr. W. P. Flint: They were made with several grades of lubricating oil emulsified with potash fish oil soap. The formula we have been using is the same as that used generally, which is one gallon of lubricating oil (we have been using Diamond paraffin oil), one half gallon of water, and one to two pounds of potash fish oil soap.

With some waters we found we had to increase the amount of potash fish oil soap and in some cases make it two pounds in order to get a good emulsion. We have used these in all cases in actual spraying in the orchards at a two percent strength. In another experiment the lubricating oil emulsions were tested at strengths of from one to six percent oil. All scale wet with the two to six percent emulsion was killed.

Mr. W. J. Schoene: In the wintertime?

Mr. W. P. Flint: The work was done early in March.

Mr. O. I. Snapp: Was any of that work done on peaches?

Mr. W. P. Flint: We have not used it much on peaches because we felt it was dangerous, and expected injury. Apparently the two per cent oil emulsion can be combined with 4-4-50 Bordeaux and used at the

time when the aphis are clustered on the outside of the buds, giving a combined fungicide, aphicide and scale spray. At a two per cent strength these emulsions will kill the aphis.

Mr. W. J. Schoene: And will not injure the foliage?

Mr. W. P. Flint: No injury occurred in our experiments last year.

Mr. E. N. Cory: What time of year do you get your first crawling young?

Mr. W. P. Flint: Last year the 27th of May, where we were working.

Mr. O. I. Snapp: Do you think one per cent or one and one-half per cent emulsion will control?

Mr. W. P. Flint: We didn't get perfect control until we got up to two per cent.

Mr. J. S. Houser: Last year I had the privilege of visiting this district in company with Mr. Flint, and the existing condition is the most disconcerting thing along the line of insect control that I have seen happen for a good long while.

We have become, I am afraid, rather complacent in our assurance of our ability to control San Jose scale. It illustrates the point that we as economic entomologists must be on the lookout for new developments with old pests. We simply cannot allow ourselves to become less alert in our observations and in our recommendations.

And since Dr. Howard has compared a part of this program with an earlier meeting in Europe, I should like to compare this section of this program with a part of the program of this Association some years ago, when we heard discussed the use of parasites in the control of San Jose scale, "that the days of using sprays for controlling the scale were over—and that nature would do the job for us!"

Secretary A. F. Burgess: I think that matter might be taken back a step farther, when lime sulphur was used experimentally in the East in a number of places and found ineffective. Later it was used with better results. It may be that there are conditions which have not been given proper attention that will explain the whole reason why years ago it was found ineffective and then became more effective later on.

These same conditions may have been duplicated in the last year or two when the insect has been increasing enormously and doing a great amount of damage.

I believe thoroughly in what Mr. Houser has said, that we cannot be too optimistic about some of these problems that we think are settled, because there are liable to be changes in conditions and there may be

complications come up that affect the problem in such a way that the results we have been getting heretofore will not hold.

Mr. William Moore: I would like to raise the question as to the nature of lime sulphur. Manufacturers have been making progress in the development of lime sulphur and other insecticides. Have they made any changes? Is it exactly the same today as it was two years ago? Changes in manufacture might make a difference.

Mr. W. P. Flint: I did not make it clear in my talk that in the three experiments that I mentioned, two different brands of commercial lime sulphur were used and two lots of home-cooked or steam-cooked lime sulphur.

Mr. L. Haseman: We have been having somewhat the same condition in Missouri naturally, and the same conditions extend into northern Arkansas. During the summer and fall we held a number of scale meetings in the southern portion of the state and I had an opportunity of talking with Mr. Ackerman regarding his experience. We have not been losing the orchards in Missouri that they have been losing in Arkansas and in Illinois. Our better orchard men have been spraying thoroughly and all who sprayed thoroughly up to two years ago, have not lost any orchards. However, the men who have not been spraying thoroughly in the last five years have lost orchards in the last two years.

So I believe Mr. Flint is right when he says that the scale in some orchards had an opportunity of getting so thoroughly established, and so abundant, that with the mild winters, which we have been having, we have not been killing enough of them to keep them under control.

We have had some similar experience with lime sulphur solution, though not as high a percentage of living scale went through our test. Two per cent living scale was the highest we had in our tests in the central part of Missouri.

Mr. O. I. Snapp: We should not lose sight of the fact that in some sections, the effect of San Jose infestation may be attributed to the vast amount of proprietary insecticides being used. The San Jose infestations in Georgia are becoming alarming and we are much interested in this oil emulsion spray. We used it this year in an experimental way but we have not gotten any information as to its having been used on peaches. From a two per cent solution it is thought that twig injury might come.

President J. G. Sanders: Is that oil a cutting oil?

Mr. William Moore: I talked with the manufacturer but he was loath to say much about it. It is an oil which actually forms an emulsion

the particles of which are colloidal. If diluted to a milk appearance it will last for weeks or months in that condition without separating. It is manufactured by the Sun Oil Company of Philadelphia.

It is a by-product and obtained by their method of refining oil. They say that it will be standard and will not vary from time to time.

President J. G. Sanders: Has it not a commercial use as a cutting oil?

Mr. William Moore: Yes. I believe they have tried experiments with it.

Adjournment, 5 p. m.

INSECT PEST SURVEY WORK IN THE UNITED STATES

By J. A. Hyslop, *Bureau of Entomology*

Abstract

After reviewing the history of Survey work in the United States from 1889 to the present date, and recounting earlier attempts at this type of work by the Bureau of Entomology, the scope and objects of Survey work were set forth in the following words: "As I now conceive the scope of our work, the object of the Insect Pest Survey is to collect accurate and detailed information on occurrences, distribution, ecology, and relative destructiveness of insect pests throughout the United States, to study these data from month to month, and year to year, with relation to the several factors that influence insect abundance, and to prepare this information and the conclusions drawn therefrom in the form of maps and text for the use of all entomological workers throughout the country," with the ultimate object of eventually delineating insect zones in the United States and forecasting insect outbreaks.

An analysis of the chinch bug outbreaks in the State of Kansas during the past fifty years brought out a very decided correlation between the mean annual rainfall and the optimum chinch bug belt in that state. The main thesis brought forward was that Survey work, i.e., the accurate recording of insect abundance from year to year, will indicate, after a reasonable number of years, the zone of optimum ecologic conditions affecting any given insect, and the yearly abundance of an insect will be determined by the departures from these optimum conditions.

In 1893, at the fifth meeting of this Association, Dr. S. A. Forbes very aptly characterized the entomological organization as it then existed when he said: "American economic entomologists are working each by and for himself, altogether without general supervision and commonly without mutual consultation or co-operative plan, with the consequent fact that our investigations are as a whole heterogeneous, determined in each case largely by personal bias and local circumstances instead of by common objects and a general view." That this is not conducive of best results or, to put it conversely, that co-operative and

definite organization is a more efficient means of advancing our science, was recognized as early as the second annual meeting of this Association held in November, 1889, when C. V. Riley said: "In regard to the gathering of statistical information the work of the Department at Washington could be greatly facilitated by the assistance of different entomologists in their respective territories."

By the time of the third meeting of this Association in 1891 the idea of survey work was so well formulated in the minds of these pioneers of American entomology, that Riley, Osborn, and Smith were appointed as a committee of the Association to go into the matter of insect-damage statistics.

In 1893 the Division of Entomology inaugurated a systematic Insect Pest Survey, of which Dr. Howard said, before the Washington Entomological Society at its January meeting in 1895: "I have planned an extensive investigation of the question and am engaged in plotting on a large scale the actual distribution and injurious occurrence of about 150 of our most destructive species, and in this work I hope to have the assistance of most of our entomologists. The whole subject is one which is fraught with the greatest difficulty as well as interest. The broad subject of natural geographical distribution of animals and plants is a sufficiently complicated one but it becomes still further complicated when we come to consider the actual and possible distribution of cultivated species. One small phase of this subject enters naturally into the work of the economic entomologists, although it has, as yet, received no attention. This phase is expressed in the query, How far will a given injurious insect follow its natural food plants when the geographical range of the latter is extended by artificial means? This is a question which can be answered satisfactorily only by a study of each individual injurious species and the facts concerning its origin and present spread, as well as by a study of the laws governing the distribution of the food plant."

Dr. Merriam was present at this meeting of the Society and said that Dr. Howard's paper, in which a number of the more injurious species are correlated with the life zones which he himself had so recently delineated, was the first direct proof of his proposition that there is a direct practical bearing to the question of life zones.

The series of maps mentioned by Dr. Howard at that time were continued for a number of years, but the rapidly growing interest in such important economic pests as the San Jose scale, the cotton boll weevil, disease bearing insects and other matters of pressing importance,

so completely engrossed the time and very limited forces of both the Federal and State entomologists that the work was discontinued on account of insufficient co-operation. The maps, however, are now in the files of the Insect Pest Survey and serve as a background for early distribution records of many of the more important species.

So the Insect Pest Survey is inaugurating no new idea, it is hardly launching a new activity, but its work might be defined as an attempt to realize a long patent economic demand.

At the Chicago meeting (1920) of this Association the Committee on Policy made recommendations, which were later endorsed by the Association as a whole, that the Bureau of Entomology establish an Insect Pest Survey. These recommendations maintained that: "It is obvious that the early recognition of recent introductions will promote the control of newly established pests. This is an important phase of economic entomology. An Insect Survey *designed to ascertain the distribution* and the *extent of injury* caused by various insects and to keep official entomologists throughout the country *apprized of developments* during the growing season would prove of great value in forecasting probable injury. It is recommended that an Insect Pest Survey be organized under the direction of the Bureau of Entomology in co-operation with official entomologists of various States or State institutions."

Early in March, 1921, the Insect Pest Survey was formally inaugurated and has functioned now for a period of nearly two years.

As I now conceive the scope of our work, the object of the Insect Pest Survey is to collect accurate and detailed information on occurrences, distribution, ecology, and relative destructiveness of insect pests throughout the United States, to study these data from month to month, and year to year, with relation to the several factors that influence insect abundance, and to prepare this information and the conclusions drawn therefrom in the form of text and maps for the use of all entomological workers throughout the country.

The results to be obtained from this undertaking over a series of years are manifold. We should be able to throw light on the reasons for the cyclic appearance of insect pests, the gradual shift of regions of destructive abundance, the limiting barriers to normal dispersal, and the directive influences that determine the paths of insect diffusion, and the relation of climatology, geography, topography, and geology, as well as biological complexes of flora and fauna, to insect distribution and abundance. The mapping of insect life zones will aid the working entomologist in more clearly grasping the relative importance of the

problems within his own territory and may even indicate the type of agriculture that will meet with fewest entomological obstacles in a given region.

This sounds like a rather ambitious program but is, I believe, one that can be substantiated even at this early period of the Survey's development. In the State of Kansas, for instance, entomological records have been maintained for more than 50 years, not by any means as completely as they are maintained today, but nevertheless completely enough to meet the present requirements. Through the kindness of Professor G. A. Dean, the Survey was furnished with the chinch bug records for this period. These records have been mapped for the Survey files, the chinch bug being the first insect to which our new system was applied.

The maps showing the annual outbreaks, indicate that chinch bug occurs very generally over the eastern three-quarters of the State of Kansas, shifting in destructive abundance from year to year. A state map was prepared from the annual maps, upon which a dot was placed in each county for each year an outbreak was reported from that county during the last 50 years. Here we have very conclusive evidence that there is a region in Kansas where the ecological complex is highly favorable to chinch-bug development. This region extends over the three eastmost tiers of counties, and forms an almost rectangular block covering the eastern quarter of the State, wherein the mean normal conditions are optimum for the chinch bug. The map shows also that over the eastern half of the State average conditions are within the critical range of this species and that over the western third the pest only occurs when the ecological conditions are subject to such radical departures toward the insect's optimum as to bring them within this critical range.

One might argue that an insect's food plants are the limiting factors in its distribution. This is undoubtedly true within certain limits, but in this particular case the proposition breaks down. Corn and wheat are certainly the two most important food plants of this insect. The chinch bug's optimum range coincides with neither. The most intensive corn belt is along the northern border of the state extending well beyond the optimum range of the chinch bug, while the intensive wheat belt is in central Kansas, also well to the west of this chinch bug belt. The area of intense chinch bug infestation is not coincident with the two most important economic crops it attacks.

But a glance at the rainfall seems to be much more illuminating.

Here we see that the westmost limit of the area in the state having a minimum mean annual rainfall of 30 inches runs west of the optimum chinch bug belt and that two lines of 34 inches minimum mean annual rainfall lie mostly within this belt. An imaginary line probably limiting the 32-inch minimum mean annual rainfall area in Kansas would practically coincide with the westmost border of the optimum chinch bug area.

Data of this type, when brought together for all the states, will possibly show a maximum rainfall limit. It may not be an annual mean but a monthly maximum or even a daily maximum within a very limited period.

Cases may develop in which an entirely different factor or group of factors may be critical, such as elevation, rate of evaporation, intensity of light, soil, vegetation, or natural enemies. Can anyone doubt that the determination of the critical ecological factors will make possible the prediction of insect outbreaks? Is it not evident, if an insect is confined to a given region in which a given set of known conditions prevail, and if this insect only occurs outside of this region when the conditions in the contiguous territory are modified, either by departures from normal climatic conditions or by the handicraft of man, that we can, by examining the known conditions with the current conditions, foretell insect outbreaks as accurately as weather conditions are now prognosticated?

Another phase of the value of Survey work is the forecasting of the probable spread of newly introduced pests. This, of course, is subject to much more frequent error than the direct record type of forecasting just outlined. In this work we take the normal range of a closely allied species and use this as an index of the possible extent of its newly introduced congener. For example, the Mexican bean beetle within the last few years has become a serious pest in the Lower Mississippi Valley region. This pest was normally confined to the foothill regions of the Southwest and Mexico. It is now well established over Alabama, parts of Georgia, North Carolina, South Carolina, Tennessee, and Kentucky. How far to the North, South, and East will this insect be able to maintain itself? We turn to the closely related species, *Epilachna borealis* as an indicator and find that this species has been recorded over practically the entire humid austral region of Merriam. The two beetles hibernate under very similar conditions. The normal food of the introduced species is abundant throughout this entire region, so we have evidence which should lead the thinking entomologist to organize for the advent of this species as far north as Southeastern Massachusetts

and Southern Michigan. Of course, *Epilachna corrupta* may not be able to withstand the winter conditions that *Epilachna borealis* tolerates, but there is no better criterion in such cases than that here suggested.

A second function of the Survey is its service; this, though but incidental to its main object, is of considerable value. The Survey attempts to discover and rapidly disseminate information relative to recently introduced pests; unusual epidemics of native or well established pests; and migration and first appearance of destructive migratory insects, indicating the rate and direction of migration; also to collect statistics and complete data regarding losses occasioned by insect pests. The reporting of newly introduced pests should be carried on in close co-operation with the Federal Horticultural Board, State Plant Boards, Nursery Inspection Services, and other regulatory organizations throughout the country.

A Survey should not investigate life histories of insects, devise means of control of pests, or undertake extension or eradication work.

The Insect Pest Survey is a co-operative organization in the broadest sense of the word. It obtains its data through collaborators in the several States, Fifty-nine collaborators are now functioning. These are largely Entomologists of the Agricultrual Experiment Stations, State Entomologists, and Entomologists in the State Universities and Agricultural Colleges.

The organization of the Survey may be divided into two branches: One, the Headquarters Office, known as the Office of the Insect Pest Survey of the Bureau of Entomology, United States Department of Agriculture, Washington, D. C., and the other, the Collaborators' Offices located in the several States.

The Headquarters Office functions in receiving all notes from the collaborators, maintaining files of these notes in such a form as to be always immediately available, reviewing literature, mapping distribution, and summarizing these reports immediately for monthly, and later in a more critical manner, for the annual publications. It correlates the insect data received with the climatological, topographical, and ecological data to which it has access, and, finally, draws conclusions based upon these investigations. It should, eventually, have a corps of trained surveyors who could be sent out on special surveys augmenting the survey forces in the several States and teaching survey assistants at the stations approved methods in order to make the results more easily comparable.

The collaborators' offices function in directing the field surveys in

their respective territories, correcting, revising, and otherwise preparing notes for transmittal to Washington, and assume responsibility for all contacts necessary in carrying on Survey work in their respective territories.

The Survey uses four channels through which to disseminate the information gathered. (1) Very urgent information that might be of practical value to the working entomologists is transmitted by telegraphic reports. (2) Matters of immediate interest, but not of so urgent a nature as the telegraphic reports, are published in the form of mimeographed sheets in a continuous series known as Special Reports. These are usually issued within three days after the information is received in Washington. (3) A Monthly Bulletin is issued for the timely dissemination of information on distribution, abundance, and destructiveness of insect pests. (4) The Annual Summary for a final digest of each year's survey activities.

During the last two years 15 numbers, comprising two volumes, of the Bulletin have been issued, covering 565 pages. Up to December 1 of this year the Survey had received notes on 868 species of insects of economic importance. This, in itself, is worth considering, as it visualizes the enormous complexity of our science. In two years 868 different organisms have come to the attention of the American economic entomologist, each organism with individual differences which must be known by the economic entomologist before he can proceed intelligently with control measures. Without a survey, to coordinate and furnish continuity to these records, would not the mass of this information have been lost to the general advancement of our science?

The Insect Pest Survey is now well launched, the co-operation of the Entomological agencies in the several States has been most encouraging, and any deficiencies have been, I believe, in every case due to a failure to appreciate the scope of our work. This activity is fundamental research on a very comprehensive scale and I believe that with your hearty support, will accelerate the advancement of entomological knowledge as will no other one activity to which we are now bending our efforts.

PROGRESS REPORT OF INVESTIGATIONS RELATING TO REPELLENTS, ATTRACTANTS AND LARVICIDES FOR THE SCREW-WORM AND OTHER FLIES

By F. C. Bishopp, F. C. Cook, D. C. Parman, and E. W. Laake, *United States Department of Agriculture*

Abstract

Among many tests of baits for use against the screw worm fly, (*Chrysomya macellaria*) and its relatives dried egg was found to be one of the most satisfactory. Over two hundred chemicals were tested as repellents for use on live stock. Some of the most promising were furfural, safrol, salicylic aldehyde, several essential oils—namely cloves, cassia, citronella, fennel, sassafras and anise—pine tar oils and certain camphor oils. A very effective repellent for practical use is a mixture of one part furfural to four parts pine tar oil. As a larvicide for use on wounds benzol is satisfactory.

The need for a detailed study of the chemotropic responses of various species of flies has been pressing for years. The economic importance of one phase of the problem, viz., the losses caused by the screw worm and other blowflies is world wide. In the southwestern United States they cause a loss to the live stock industry estimated at four million dollars per year. The losses to the sheep industry of Australia are placed at twenty million dollars annually and heavy losses are experienced in tropical America, India and Africa.

The problem of their control has been under investigation by the Bureau of Entomology since 1915 when an investigation of the relation of flies to the packing houses under government control was undertaken in co-operation with the Bureau of Animal Industry. A study of the control of the screw worm fly in the Southwest was started the same year. During the past two years the Bureau of Chemistry has co-operated in the work on these investigations and they have been pushed whenever seasonal and other conditions were favorable.

The field is large, covering the responses of different species of flies to various chemicals, etc., both attractants and repellents. While considerable progress has been made the problem has many aspects and it is planned to continue the co-operative work and to apply the information obtained in the present studies to other species of flies.

The experiments thus far have been divided into three groups (1) Seeking chemical groups or combinations that will attract flies of economic importance, especially blowflies and house flies, (2) Seeking groups or combinations which will repel these flies from decomposing meat or similar materials which are particularly attractive to them, (3) Seeking ovicides and larvicides suitable for use on infested live stock.

In the early stages of the work jars containing meat were treated with

various chemicals and other substances. Records of the number of flies in each jar at different times each day, the presence of eggs and larvae and the ovicidal and larvicidal effects of the chemicals were made. In addition to testing the chemicals directly on meat in jars, experiments were made in which they were incorporated with carriers such as mineral oils, petrolatum and inert powders, and applied to the meat or to wounds.

Some two hundred substances were tested and of these a few such as acetone and amyl butyrate apparently have attractive qualities for flies. Others, such as furfural, safrol and salicylic aldehyde, several essential oils, viz., anise, cassia, clove, citronella, fennel and sassafras, various pine oils, certain camphor oils and artificial mustard oil have shown definite repellent value. The pine tar oil having the greatest repellent actions has not been determined nor have we determined the exact status of all the various substances mentioned.

Several chemicals have been found to possess a larvicidal effect. Among these are nitrobenzene, bromoform, furfural, safrol, pyridine, sassafras oil, salicylic aldehyde and others, but many are too toxic to be used on animals. It will be noted that repellent and larvicidal actions are, in some instances, shown by the same material. Some larvicides are not sufficiently toxic to larvae to warrant their use on wounds and many lack the volatility needed to produce a larvicidal action deep in the tissue.

Of the larvicides for wound treatment 100% benzol has been found more satisfactory than chloroform, xylol or carbon tetrachloride. Cresols and phenols are not to be generally recommended. Bromoform, while satisfactory for use on wounds, is very expensive.

The first practical problem was to find satisfactory materials for application to animals infested by the screw worm fly. These materials must exert repellent properties for several days, i. e., until the wound heals and therefore is not attractive to flies. They should also be non-injurious to the host and preferably have larvicidal action. They must adhere well and possess certain other properties. Of the various mixtures tested several have shown some value and one composed of one part of furfural and four parts of pine tar oil has proven very satisfactory. Another economic phase of the problem is to find repellents suitable for use in protecting meat and other food stuffs from fly contamination.

The second practical problem was to find effective bait for blowflies. This bait must be suitable for shipment and for use in various places where flies may be trapped, such as around slaughterhouses, on ranches,

etc. Gut slime, the mucous lining of hog and cattle intestines removed during their preparation for sausage casings, is very attractive to these flies. As fresh slime can not be shipped the drying of the material was tried. The dried product however, proved less attractive to the blowflies than the fresh slime probably due to the volatilization of amines and ammonia and certain acids during the drying process. The bacterial flora was also reduced by the drying.

Experiments conducted recently have shown that dried whole egg or dried egg yolk when moistened and kept alkaline makes a very attractive bait for flies. The dried egg material which is available commercially and that which may be made from eggs not suitable for food has given excellent results around packing houses and on the cattle ranges. Dried egg material made from off grade eggs must be clearly labeled to show that it is unfit for food purposes. A reduction in the number of screw worm cases among cattle has been noted on ranches where this bait has been properly used with traps.

A mixture of dried egg, water and sodium carbonate in the following proportions is recommended: 170 grams (6 ozs.) dried egg, 2 quarts of water, and 5 grams (1/5 oz.) sodium carbonate. The mixture should be placed in clean bait pans under suitable traps. It is important to keep the bait moist, and to add sodium carbonate occasionally to keep the mixture alkaline.

Other protein material such as rabbit carcasses may be used in traps, the essential point being the development of protein decomposition products and their expulsion by alkaline conditions. The objection to the development of fly larvae in baits composed of meat products has been met by the use of a larvicide surrounding such baits in the pans. Solutions made by mixing 10 cc. (1/3 oz.) of 40% nicotine sulphate solution or by dissolving 15 grams (1/2 oz.) of borax in 2 quarts of water proved satisfactory.

The species of flies studied principally in the tests of attractants and repellents were (arranged approximately according to abundance) *Musca domestica* L., the screw-worm fly (*Chrysomya macellaria* Fab.), black blowfly (*Phormia regina* L.), greenbottle fly (*Lucilia sericata* Meig.), *Piophila casei* L., *Sacrophaga* spp., and *Ophyra leucostoma* Weid.

THE CITRICOLA SCALE IN JAPAN, AND ITS SYNONYMY

By Curtis P. Clausen, *Yokohama, Japan, United States Department of Agriculture, Bureau of Entomology*

During the seasons of 1916–17 the writer had occasion to make a study of the citrus insects of Japan with particular reference to the securing of parasites for use against these pests in California. The number of soft scales attacking citrus is quite large, and infestations almost invariably comprise several species. Chief among these are the *Pulvinaria* spp., which always occur on every tree. Prior to the formation of the ovisac certain of these are not readily distinguishable in the living condition from several species of *Coccus* infesting the same host plants. Among these latter were occasional individuals which bore a striking resemblance in coloration and form to the citricola scale of California. Later observations also revealed the fact that the eggs hatched almost immediately after being laid, this feature of the life history also being identical with that of the above mentioned species. A quantity of adult females in alcohol were forwarded to Prof. H. J. Quayle for examination, but unfortunately their condition was not such as to permit of a positive determination. Dr. S. I. Kuwana expressed the opinion that it might possibly be his *Lecanium pseudomagnoliarum.*

During 1920–22 further observations have been made and a series of specimens in balsam forwarded to the Bureau of Entomology for determination. Mr. H. Morrison, who made the examination, states that they agree perfectly with specimens of *Coccus citricola* Campbell, in morphological characters but that the specimens show some characters not conforming to the description of *L. pseudomagnoliarum.*

The latter species was described from Oji, near Tokyo, on *Poncirus trifoliata*, and an examination of the hedge from which the type material was taken showed only *C. citricola* such as had been collected elsewhere on this plant. No other species of *Coccus* were present. Arrangements were made to examine the type slides in the collection of the Nishigahara Agricultural Experiment Station and to compare them with specimens from the same series as had previously been determined by Mr. Morrison. This detailed comparison was made both by Dr. Kuwana and by the writer, and the conclusion arrived at that the two series differed in no greater degree than is common within a species of this genus. *Coccus citricola* Campbell (Entom. News, Vol. XXV, No. 5, p. 222–24, May 1914) therefore becomes synonymous with *Coccus* (*Lecanium*) *pseudomagnoliarum* (Kuwana) (Jl. Entom. & Zool., Pomona Col., Vol. VI, No. 1, p. 1–8, 3 pl., March 1914).

This species has been observed by the writer at Yokohama, Okitsu, Kobe, Moji and Nagasaki, as well as at Oji, the type locality, and its distribution therefore covers the entire range of the citrus belt in the main islands of Japan. The favored host plant is *P. trifoliata*, though it has also been observed upon the pomelo and the Unshu orange. In no instance has the scale been found in large numbers, in fact only isolated individuals can be found upon the last named hosts. The life history and habits as observed are identical with those of the species in California.

While the wide distribution in the citrus growing districts of Japan indicate that it is a long established species, yet there is doubt as to whether this is its native home. Most, if not all, of the species and varieties of citrus in Japan, with the exception of the naval orange, have come from the Asiatic mainland, though dating back some three hundred years or more. Consequently it will be necessary to study the representatives of the genus from continental Asia before this point can be finally determined. The California infestation may with reasonable certainty be considered as of Oriental origin.

Scientific Notes

Liponyssus bacoti Hirst. A mite that heretofore has not been recorded from Maryland and which has been determined by Dr. Ewing as the above caused the employees of an umbrella factory to threaten to leave unless the mites were eradicated. Help was asked of this department and an examination by Mr. Sanders disclosed the mites in the cloth and scraps. They were crawling rapidly about over the goods and they readily attacked the employees, causing a swelling like that produced by the chigger. The second floor, occupied by a pants maker was slightly infested but the first and fourth floors which were kept fairly clean were uninfested. This was on January 24, 1923 and on February 16, 1923, after a commercial rat extermination company had been at work for several weeks, the mites had entirely disappeared. Ernest N. Cory, *State Entomologist, University of Maryland.*

Powder-post beetles (*Lyctus* spp.) **and Automobiles.** The work of powder-post beetles in well seasoned wood is somewhat common and turns up in many unexpected situations. One of the latest is a complaint of the work of these beetles accompanied by injury to upholstering in one of the high priced, popular makes of automobiles. There have been in recent years several reports of powder-post beetle work in the trim of apartment houses in New York City. The trouble in every case has been due to the use of sapwood. This should be treated with some preservative before being incorporated into a costly building or an expensive machine because there is no very satisfactory method of handling the problem later, aside from the use of heat, and this simply kills the insects in the wood and does not prevent reinfestation.

E. P. Felt

Zoological Record assisted by the Imperial Bureau of Entomology. The attention of Entomologists throughout the world is called to the fact that, beginning with the Volume for 1922, the preparation of the "Insecta" part of the "Zoological Record," is being undertaken by the Imperial Bureau of Entomology. In order that the Record may be as complete as it is possible to make it, all authors of entomological papers, especially of systematic ones, are requested to send separata of their papers to the Bureau. These are particularly desired in cases where the original journal is one that is not primarily devoted to entomology. All separata should be addressed to:—The Assistant Director, Imperial Bureau of Entomology, 41, Queen's Gate, London, S. W. 7, England.

Tachinids and Sarcophagids Established in Mexico. It may be noted that as a matter of record the two flies *Euzenilliopsis diatraeae* Towns., and *Sarcophaga sternodontis* Towns., each parasitic on *Diatraea saccharalia* Fab., have recently been introduced into the west coast region of Mexico, from Cuba. A total of 590 adult flies of the two species were reared from some 2,550 puparia sent by the writer from the provinces of Matanzas and Habana, Cuba, during the summer of 1922, and were released on the plantations of the United States Sugar Companies, S. A., at Los Mochis, Sinaloa, Mexico. The exact number of each species released is uncertain, but the bulk of the puparia sent were of the Tachinid species. These introductions were made with a view to the control of *Diatraea lineolata* Walker, which, with *Chilo loftini* Dyar, is a sugar-cane pest of major importance in the state of Sinaloa.
R. H. Van Zwaluwenburg, *United Sugar Cos., S. A., Los Mochis, Sin., Mexico*

The Tropical Fowl Mite (*Liponyssus bursa* Berlese). This mite has been reported from two places in the United States,—Beltsville, Md. and Raymond, Ill. (U. S. D. A., Dept. Circ. 79, 1920).[1] According to the writer of the circular, both of these infestations were stamped out through active measures taken by officials of the United States Department of Agriculture. On Jan. 10, 1923, a student in the Winter Course at Cornell, brought me some feathers from fowls heavily infested with a mite. All stages of the mite were present and the fluffy parts of the feathers were almost a solid mass of eggs, nymphs, adults, cast skins and excreta. On examination it proved to be the tropical fowl mite. This student told me that he had this mite on his fowls for the past two years. He obtained some infested feathers from his fowls and the mite proved to be the same species. Accordingly the writer can report the presence of this mite at Closter, New Jersey and in two poultry yards here at Ithaca. In talking with this student he told me that his infestation appeared on his Plain Polish White fowls shortly after he had exhibited them at the Boston Poultry Show two years ago. He has had serious trouble from this mite and has been unable to control it. As the English Sparrow is a host of this species he eliminated this bird from his yards, cleaned up his fowls but still they would become seriously infested within a short time. As the Starling is a common bird about Closter, N. J. and it is known to be a host of this mite the reinfestations probably came from this source.

This mite is undoubtedly a serious pest of poultry and is said to be a carrier of spirachaetosis of fowls. Although this disease has not been recorded from the

[1]It has also been reported recently from the Poultry houses of the Indiana Agr. xp. Sta. at Purdue, Indiana as *Liponyssus silviarum*.

United States there is every probability that it may be introduced and should it become established and this mite prove a distributor of it, the seriousness of the pest would be greatly increased.

Robert Matheson

The "Language" of Bees. In the *Scientific American* for August 1922, there appeared a review of an article on *The "Language" of Bees.* There was an abstract of this review in the *Literary Digest* for Sept. 2, 1922. Altho both periodicals are widely read, these reviews appeared in such inconspicuous places in their columns that it seems doubtful whether the results reported therein are yet before the bee-keeping fraternity in America. In fact, it was not until November that these articles came to my attention. The original paper, which was published in the *Munich Medizin Wochenschrift* (1922), was by Prof. Karl von Frisch, a German investigator.

The results of Von Frisch's experiments lead to the conclusion that the "dance" performed at times by loaded fielders just returned to the hive, is a means employed to inform the other bees that food is to be had for the getting. This method of communication, however, is inadequate to give the location of the food unless that be already known to the recipient of the message.

I deem it a privilege to be able, at this time, to confirm the conclusion of Prof. Von Frisch thru observations and experiments of my own on this very subject which have been carried on here at the Iowa Experiment Station at intervals ever since the summer of 1919. A brief description of the "dancing" bee as seen in a one frame observation hive appears in my notes on "Behaviour of Water Carriers" recorded Dec. 29, 1919, and is as follows: "Attention was soon attracted to certain individual workers that would come in, bustling and business-like, thru the throng. Such an individual was soon set upon by other workers (the number varying from 2 to 5) that followed her as she turned round and round, darting this way and that in make-believe efforts to free herself from these meddlers, like a puppy with a bone, set upon by other puppies."

In my notes for April 19, 1920, under the caption, "Some Maneuvers Seen in an Observation Hive," I referred to the above description and recorded my tentative conclusion regarding the significance of the "dancing" bee as follows: "Characteristic of a worker that *has located a source of pollen, nectar or water* and has a load to give up. Possibly such a bee is *trying to attract the attention of other bees in order that they may help carry home the plunder.*"

On the same day, April 19, 1920, I reported the above conclusion to Dr. E. D. Ball, who at that time had supervision of my work and who now is Director of Scientific Research in the U. S. Department of Agriculture. A few days later, I confided the matter to Prof. F. B. Paddock, State Apiarist of Iowa, and since that time have mentioned my observations on this subject to a limited number of others.

Further observations showed that, with some exceptions, an individual that attempted to approach the "dancer" left for the field in less than two minutes after coming in contact with her. Some would leave at once but others appeared to find it necessary to prepare for the trip by securing a little food from other bees or from a cell.

Thus, working independently, the two of us arrived at the same conclusion at about the same time.

Wallace Park
Iowa Experiment Station

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1923

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded or the proof returned, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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It would appear that abstracts are somewhat acceptable or that most of our readers are conservative and willing to give the plan a test before expressing an opinion. Most of the abstracts in this issue were prepared by the authors, those who should know the contents of the individual papers. The abstracts in the February number were prepared by the editor and revised more or less by the various authors. It should be possible to develop shortly a type of abstract which may prove of great service to all readers. The viewpoint of the man unacquainted with the subject matter should be kept constantly in mind. The JOURNAL, thanks to the efforts of the Business Manager, the Circulation Agent and their numerous helpers, has a wide circulation distribution. It is not too much to hope for a much greater increase in the number of subscribers. Well prepared abstracts may greatly aid by bringing the contents of the JOURNAL to the favorable attention of many who at first could not be induced to read entire articles. The abstract is one method of emphasizing the interdependence of the various branches of science, since it is a great convenience to workers in allied lines and may easily result in economic entomology coming more nearly to filling the important sphere falling within its domain.

Current Notes

Mr. W. G. Garlick, B.S., University of Toronto, holds a fellowship in Entomology in the University of Kansas.

Prof. H. A. Gossard spent a week during the holidays with his aged mother and other relatives in Iowa.

Mr. R. H. Beamer has been elected to the position of Assistant Curator of the Entomological Collections of the University of Kansas.

Mr. E. H. Siegler of the Bureau of Entomology attended the annual meeting of the Maryland Horticultural Society at Frederick, Md., January 9-11.

According to *Science*, Dr. G. H. Carpenter, Professor of Zoology at Royal College of Science, Dublin, has been appointed Keeper of the Manchester Museum.

The following appointments in the Bureau of Entomology are announced: W. W. Porter and J. A. McLemore, Mississippi and Torbert Slack, Louisiana, sweet potato weevil eradication.

Miss M. E. Bellows and Miss Jean Bostock have recently been appointed laboratory assistants in the Division of Systematic Entomology, Entomological Branch, Canadian Department of Agriculture.

According to *Experiment Station Record*, Mr. J. S. Yankey, inspector in the Department of Entomology and Botany, Kentucky Station, has been succeeded by Mr. Max Braithwait.

Miss Kathleen Doering, A.B., University of Kansas, has been elected to the position of Assistant Instructor in Entomology and Scientific Illustrator in that Institution.

Dr. Herbert Spencer, Assistant Professor of Entomolgy and Zoology, North Carolina College, has been appointed Associate Entomologist in Charge of Investigations of Insects Affecting Truck Crops.

Mr. P. A. Readio, Instructor of Entomology in the University of Kansas, has recently been placed in charge of the Experimental Laboratory and Insectary of that Institution.

Mr. A. J. Ackerman of the Bureau of Entomology was slated to attend the meeting of the Ohio State Horticultural Society, Columbus, Ohio, January 30 to February 1.

Dr. W. M. Wheeler gave the address of the retiring President at the dinner of the American Naturalists at the Boston meeting. His subject was "The Dry Rot of Academic Biology."

Mr. A. B. Baird returned to Fredericton, N. B., on February 9 after spending four weeks rearranging certain subfamilies of parasitic Hymenoptera in the Canadian National Collection of Insects at Ottawa.

The following transfers in the Bureau of Entomology have been announced recently: W. D. Whitcomb, Yakima, Wash., to New Orleans, La.; C. A. Weigel, temporarily, Washington, D. C., to New Orleans, La.

Dr. H. B. Hungerford, Professor of Entomology in the University of Kansas, will be on the instructional staff for research and investigation at the Univeristy of Michigan Biological Station next summer.

Announcement has been made of the following resignations in the Bureau of Entomology: H. B. Lancaster, junior entomologist, Mexican bean beetle, Alabama; F. B. White, plant quarantine inspector, sweet potato weevil, Mississippi.

Professors J. Chester Bradley, O. A. Johannsen and Robert Matheson will be instructors in entomology at the Cornell University Summer School of Biology at Ithaca, N. Y., July 7 to August 17, 1923.

Mr. T. E. Holloway of the Bureau of Entomology will travel through Mexico

during the fiscal year of 1923, for the purpose of investigating sugar-cane insects and the distribution of the cotton boll weevil.

Professor C. E. Sanborn, Professor of Entomology at the Agricultural and Mechanical College of Oklahoma, is on Sabbatical leave and now taking work at the University of Kansas as a candidate for an advanced degree.

Mr. O. I. Snapp of the Bureau of Entomology addressed the meeting of the Tennessee State Horticultural Society, January 30, and attended a meeting of the Science Club of the University of Georgia on February 23.

Mr. C. H. Curran, B. S., University of Toronto, has recently completed his work for an advanced degree at the University of Kansas and has accepted an appointment on the staff of the Dominion Entomologist of Canada.

According to *Science*, Dr. James G. Needham of Cornell University, who is spending the year at Pomona College, gave an address at Los Angeles on February 10 before the Sigma Xi Club of Southern California.

Dr. J. K. Haywood of the Bureau of Chemistry and Chairman of the Federal Insecticide and Fungicide Board, is now absent on a two month's assignment in California, where he will study problems relating to insecticides and foods.

Mr. C. H. Popenoe of the Bureau of Entomology attended the convention of the National Canners Association at Atlantic City, N. J., during the week of January 24, and supervised the installation of the exhibit of the Bureau of Entomology.

Volume XIV of the University of Kansas *Science Bulletin* is now in press. This volume will be devoted entirely to Entomological papers, results of investigations of members of the faculty and graduate students of the Department of Entomology.

According to *Science* Mrs. Anna Botsford Comstock has beeen nominated for trustee of Cornell University. Mrs. Comstock was nominated for this position in 1922, and, though losing by a narrow margin, polled a larger vote than any previous winner.

On February 13 at the meeting of the New Jersey Mosquito Extermination Association, Dr. T. J. Headlee was presented with a gold watch in commemoration of his ten years' service as Secretary of the Association and as State Entomologist of New Jersey.

On February 14, Dr. L. O. Howard, Chief of the Bureau of Entomology, read a paper before the tenth annual meeting of the New Jersey Mosquito Extermination Association at Atlantic City, N. J. On the 13th, he addressed the Japanese Beetle Club at Riverton, N. J.

Prof. H. L. Viereck of the Biological Survey, while in Philadelphia the last week of February, compared specimens of Hymenoptera in the Biological Survey collection with type specimens in the collection of the Academy of Natural Sciences with a view to ascertaining correct identifications.

The laboratory of the Bureau of Entomology at Wallingford, Conn., has been discontinued and Dr. B. A. Porter has been transferred to Vincennes, Ind., where, in co-operation with the Purdue University Agricultural Experiment Station, investigations will be undertaken of the more important fruit insects of southern Indiana.

C. P. B. Lawson, Professor of Entomology in the University of Kansas, has recently been selected as Assistant Dean of the College of Liberal Arts and Sciences at

the University of Kansas. Dr. Lawson will devote half of his time to administration and half to research and teaching.

Mr. C. H. Popenoe, entomologist, Truck-crop Insect Investigations, Bureau of Entomology, recently attended the convention of the National Canners' Association at Atlantic City, N. J., January 22-26, having charge of the Bureau of Entomology exhibit on the European corn borer, Japanese beetle, pea aphis, and other truck crop insects.

At an Institute for Tree Workers at the Agricultural Experiment Station, New Haven, Conn., March 1, arranged by the Tree Protection Examining Board of the State of Connecticut, illustrated entomological addresses were given as follows: Mr. A. F. Burgess, "The Gipsy Moth;" Dr. E. P. Felt, "Some Insects Attacking Shade Trees."

Dr. E. D. Ball left Washington February 4 for Memphis, Tennessee to attend the meeting of the Southern Agricultural Workers. Before returning to Washington, Dr. Ball was scheduled to give addresses at Manhattan, Kansas, and Ames, Iowa, and to visit Lincoln, Nebraska, to confer with the University officials on research problems.

Mr. William Middleton of the Bureau of Entomology returned to Washington on January 18 after a short trip to Columbus, Ga., for the purpose of investigating the conditions of the sugarberry shade trees of that city, which are infested by scale insects, and advising the municipal authorities regarding methods of control.

Dr. M. D. Leonard of the Bowker Insecticide Company has been appointed Associate State Entomologist of New York and will take charge of the office of the State Entomologist May 1, an arrangement necessitated by the transfer of Dr. Felt to the State Conservation Commission.

The laboratory of the Bureau of Entomology at Medford, Oregon, has been discontinued, and M. A. Yothers, who has been in charge of this station, has been transferred to the bureau's laboratory at Yakima, Wash., where he will be associated with E. J. Newcomer in the continuation of fruit insect investigations of that region.

At a meeting of the American Agricultural Editors Association, held February 27 and 28 at the Department of Agriculture, Washington, D. C., the following addresses were made by entomologists: "The value of Research," Dr. E. D. Ball; "Plant Quarantine Laws," Dr. C. L. Marlatt; "Recent Advances in Fruit Insect Control," Mr. E. H. Siegler; "Apiculture," Dr. E. F. Phillips.

Mr. J. E. Dudley, Jr., assistant entomologist, Bureau of Entomology, stationed at Madison, Wis., recently attended the National Canners Association Convention at Atlantic City, N. J., January 22-26, where he presented a paper outlining the plans of the department in undertaking work against the pea aphis in Wisconsin and other portions of the United States, in co-operation with State Entomologists and representative canners.

Dr. E. D. Ball returned February 24 from a speaking trip in the course of which he addressed the New York Farmers' Club at New York City; on February 21, the Japanese Beetle Club at Riverton, N. J., on February 23, the Journal Club of the Department of Medical Sociology of the School of Hygiene and Public Health of Johns Hopkins University.

Mr. Wilmon Newell, director of the Florida Agricultural Experiment Station,

visited Washington January 9, and reported that plans have been made by the Station staff and co-operative extension workers of Florida and the cotton growers of the State for a general trial of the boll weevil eradication method practiced for the first time by that Station last season with promising results.

The field leaders in the Hession fly investigations of the Bureau of Entomology conferred in Washington on January 3. Those in attendance were W. H. Larrimer, W. B. Cartwright, A. F. Satterthwait, J. R. Horton, C. C. Hill, C. M. Packard, J. S. Wade and W. R. Walton. Messrs. P. R. Myers and W. J. Phillips were prevented from attending by illness. The conference, as usual, yielded valuable results in the co-ordination of methods and effort.

Mr. A. F. Satterthwait, in charge of the Webster Groves, Mo., station of the Bureau of Entomology recently broadcasted a lecture from St. Louis, Mo., telling of the functions of the Webster Groves station and its relation to the agriculture of the region. This was part of a series of talks arranged by the local U. S. D. A. Club with a view to popularizing the work of the department.

The Australian tomato weevil (*Desiantha nociva* Lea) has been found to be established at a number of points along the coast of Mississippi in addition to the previous inland infestation. It is now reported from five distinct places in Harrison County, two in Stone County, and one in Jackson County. This indicates that the original introduction occurred presumably at an earlier date than was heretofore supposed.

The brown-tail moth work in New Brunswick was completed on January 27 by Messrs. Finnamore and Simpson. Practically the same area was covered as in 1921-22 and no sign of the insect was seen. The work in Nova Scotia has been seriously handicapped by the very severe snow storms. Up to January 27, 422 winter nests have been collected as compared with 757 for the same period last year.

The legislature of New York has passed a bill giving the Conservation Commission wide discretionary powers for the control and preventing the spread of the gipsy moth and appropriating $150,000 for the work, thus legalizing the barrier zone which has been under discussion for the last few months. Mr. H. L. McIntyre of the Federal Gipsy Moth work has been appointed Superintendent and Dr. E. P. Felt, Chief Entomologist, the latter being transferred from the office of the State Entomologist with tenure of title.

A New Entomological Laboratory in Ceylon.—In the November issue of *The Tropical Agriculturist* which is published at Peradeniya, Ceylon, an account is given of the opening of a new Entomological Laboratory, which is situated at the very entrance of Peradeniya, the heart of the agricultural life of Ceylon. The Entomological Laboratory consists of two rooms for Entomologists, two for Assistants and students, a dark room, an insectary, a store room, a library and lecture room, a room for collection, and a room for the clerk. The opening of this laboratory and a similar Mycological Laboratory took place on October 10, 1922, at which the Governor was present and made an address, as did the Director of Agriculture for the Colony. In the course of his address the Director remarked that the entomological work in Ceylon reflects great credit upon those scientific workers, such as Mr. E. E. Green and his present successors Dr. J. G. Hutson and Mr. Jepson.

According to *Entomological News*, Mr. Henry John Elwes, F.R.S., F.E.S., died November 26, 1922, at his home, Colesborne Hall, Cheltenham, England, at the age

of 76 years. He was an authority on the Palearctic Rhopalocera, and his extensive travels included portions of North America. He was president of the Entomological Society of London in 1893 and 1894 and was elected a corresponding member of the American Entomological Society in 1897.

At the dinner held Friday afternoon at the University Club an address was given by Doctor W. L. Burlison, Head of the Agronomy Department, University of Illinois on: "What the Entomologist should be doing from the Agronomist standpoint." This was followed by a short symposium on control of field crop insects.

Mr. H. S. Adair, a graduate of the Mississippi A. & M. College, has been appointed field assistant to assist with the plum curculio studies that are being conducted at Fort Valley, Georgia, by the Bureau of Entomology.

On January 30th, Mr. Oliver I. Snapp, of the Bureau of Entomology, with headquarters at Fort Valley, Ga., gave an address at the Annual Meeting of the Tennessee Horticultural Society at Nashville, Tenn., on recent developments in peach insects control. He also spoke on a similar subject at the Annual Meeting of Southern Agricultural Workers in Memphis, Tenn., on February 6th, and at the University of Georgia, Athens, Ga., on February 23rd.

Mr. W. V. Tower, entomologist of the Federal Agricultural Experiment Station, Mayaguez, Porto Rico, has been granted leave of absence from his Station duties to make a study of methods of combating the tobacco, or cigarette, beetle, which is doing considerable damage in the factories and warehouses of the Porto-Rican-American Tobacco Co. Extensive fumigation experiments are to be conducted to determine the possibility of controlling this pest under the conditions prevailing in Porto Rico.

Mr. C. H. Curran, Entomological Branch, Canadian Department of Agriculture, has just returned from a three week's trip to Washington, New York, Boston and Cambridge, where he studied numerous types of Diptera in connection with the determination of Canadian material in various families of this order. Mr. Curran reports that as a result of his work a number of new Canadian species can now be described and the types deposited in the Canadian National Collection of Insects.

A conference of Entomologists of the States in the northern part of the Mississippi Valley was held at Urbana, Illinois, March 2 and 3. The following men were in attendance:—

Mr. J. E. Dudley, E. L. Chambers, C. L. Fluke of Wisconsin; J. W. McColloch of Kansas; K. C. Sullivan, A. F. Satherwait of Missouri; H. T. Dietz, W. H. Larrimer, J. J. Davis and B. A. Porter of Indiana; T. H. Parks, H. A. Gossard of Ohio; J. H. Bigger, C. C. Compton, S. C. Chandler, W. D. Balduf, T. H. Frison, R. D. Glasgow, C. L. Metcalf, P. A. Glenn, S. A. Forbes and W. P. Flint of Illinois.

The following subjects were discussed:—The European Corn Borer; The present chinch-bug situation; The Hessian Fly; The recent increase in damage by San Jose scale and the place of lubricating oil emulsions in control; What attitude should be taken regarding the increase in soybean and cowpea acreage, in view of the threatened invasion by the Mexican Bean Beetle; Garden truck insects; Grasshoppers; Clover insects; Peach tree borer control with para-dichlorobenzene; The present status of dusting; Shall we recommend spreaders; Recent developments in plant disease work and their significance in insect control; New developments in control of sorted grain insects; Peach Thrips; Potato leaf hopper and Forest insects.

Efforts toward the control of the Mexican bean beetle have been rewarded by the discovery of a very promising parasite. Mr. E. Graywood Smyth, who was sent by the Bureau of Entomology in early May to Mexico to search for natural enemies of the bean beetle, has discovered a tachinid parasite that preys upon at least two species of *Epilachna* and seems to restrict itself to that genus. It was responsible for a very high fatality among *Epilachna* larvae in the Valley of Mexico and at Cuernavaca. In the neighborhood of 2,000 living puparia of this fly were sent to the Birmingham, Ala., laboratory and from this material Neale F. Howard, in charge of the laboratory, has succeeded in rearing one generation from native *Epilachna* larvae. A considerable number of puparia are now being held in hibernation for the coming spring. In addition, Mr. Smyth found in Mexico two varieties of beans which show promise of resistance to the injurious attack of the bean beetle, one of them, a native edible white bean, known as "ayocote," which is cultivated on a fairly large scale in sections, the other a wild brown bean of the genus *Phaseolus*. The latter grows very abundantly along streams in southern Mexico, climbing bushes and other vegetation, and the rather leathery foliage which it produces is very seldom attacked by the bean beetle, so that there is a possibility of the bean proving of great value for hybridizing with cultivated varieties to breed a resistant stock.

At the ninth annual meeting of the Entomological Workers of Ohio Institutions held at the Ohio State University, Columbus, Ohio, February 2, the following officers were elected: President, Clifford R. Cutright, Vice-President, J. W. Bulger, Secretary, C. H. Kennedy. Visiting entomologists were: S. B. Fracker, Madison, Wis; W. J. Schoene, Blacksburg, Va; W. H. Larrimer, West LaFayette, Ind; G. A. Runner, Sandusky, O.; F. W. Poos, Sandusky, O.; T. L. Guyton, Harrisburg, Pa ; R. D. Whitmarsh, Wooster, O. The program was as follows: C. R. Neiswander, The Tracheal System of *Ranatra fusca;* J. S. Hine, The History of the Ohio State University Entomological Collection; T. J. Naude, Representative Genera of Cicadellidae in South Africa; E. W. Mendenhall, Some Observations on Economic Entomology; D. M. DeLong, Recent Observations upon Toxicity of Nicotine; J. T. Potgieter, Remarks on South African Aphids; C. R. Cutright, Fall Activities of Some Common Aphids; F. H. Lathrop, The Environment of Aphids; T. H. Parks, A Progress Report of Hessian Fly Studies; J. S. Houser, The Present Status of the San Jose Scale; C. H. Kennedy, A Record Bumblebee's Nest; M. O. Lee, Mechanism of Respiration in Certain Orthoptera; Herbert Osborn, Personal Contact with Pioneer Entomologists; Albert Hartzell, The Potato Leaf-hopper and Hopperburn; H. A. Gossard, Life History of the Codling Worm in Ohio; W. J. Schoene, The Problems and Opportunities for Entomological Investigations in Virginia; J. W. Bulger, Some Researches with Paradichlorobenzine; W. G. Stover, Some Plant Diseases Know or Likely to be Transmitted by Insects; R. C. Osborn (Subject to be selected.); A. E. Miller, The Cabbage Looper and Common Ear Worm at Chillicothe; E. C. Cotton, Steps in the Enforcement of Inspection and Quarantine Regulations. The following resolutions were adopted:

(1) *Resolved,* That the Entomological Workers of Ohio express their thanks to the Federal Bureau of Entomology for the excellent exhibit of photographs and other material to illustrate the work of the European corn borer and that we likewise thank Mr. J. S. Houser for his sucessful effort to secure this exhibit.

(2) That the Entomological Workers in Ohio State Institutions assembled in annual meeting respectfully urge the calling of a national conference to determine the future policy for the control of the European corn borer. This conference to be held preferably at Cleveland during the summer or fall of 1923 and to incud

representative farmers, state and federal entomologists of all states affected or likely to be affected by this pest.

(3) That we urge upon our legislature the imperative need of making liberal appropriations for the control of the European Corn Borer by scouting and quarantine methods and for the thorough study of the behaviour of this pest under Ohio conditions.

(4) That we express our appreciation of the efficient and wise management of the Bureau of Plant Industry under the direction of Professor E. C. Cotton for several years, and that we respectfully urge that the high standards maintained by Mr. Cotton shall continue to be maintained in this State Bureau.

(5) That we express our thanks to our visitors from various places for the contributions they have made to our program and for participating in our discussions. We invite them to come again.

(6) That we thank the officials of Ohio State University, particularly those in charge of the Department of Zoology and Entomology, for the rooms and equipment provided for our meeting and other arrangements for our comfort and entertainment.

H. Osborn
H. A. Gossard
Richard Faxon
Committe

Notes on Medical Entomology

Dr. L. O. Howard and Professor C. T. Brues each gave papers on the relation of insects in the transmission of human diseases before Section N, Medical Sciences, at the Boston meeting of the American Association for the Advancement of Science, December, 1922.

Dr. W. V. King, in charge of the investigations of the Bureau of Entomology on malaria mosquitoes at Mound, La., attended the Malaria Conference held at Johns Hopkins University in Baltimore, during January. Dr. King will remain in Baltimore for several weeks working up malaria and mosquito statistics.

The Dallas, Texas, laboratory of the Bureau of Entomology prepared a booth on insects in relation to disease at the Dallas Health Show which was held in Dallas from March 13-17. By means of living and mounted specimens, photographs, models, etc., an effort was made to popularize this field of entomology which is of such vital importance, especially in the South.

Health authorities, sanitariums and entomologists are giving some attention to plans calculated to reduce the chances of another outbreak of dengue fever in the South during the present season. The mild winter which has been experienced in Texas has permitted yellow fever mosquitoes to winter successfully, at least in the coastal region, thus apparently providing an opportunity for the spread of the disease early in the season.

Horticultural Inspection Notes

An interesting Cerambycid, *Nyssodrys contempta* Bates, was recently intercepted at the Inspection House in Washington, D. C., by Mr. H. Y. Gouldman in pulp of "Pejbae," *Guilielma utilis*, from Limon, Costa Rica.

Mr. W. H. Lyne, Inspector of Horticultural Products at Vancouver, B. C., re-

ported on December 21 the finding of sixty beetle larvae among the roots of four plants, part of a consignment from Japan.

Mr. A. G. Webb, in charge of the work of the Federal Horticultural Board at Seattle, Washington, has been temporarily transferred to Washington, D. C., to assist in the inspection of plants introduced under special permit.

Mr. W. B. Wood during the month of February inspected the plants for distribution at the field stations of the Office of Foreign Seed and Plant Introduction at Savannah, Ga., and Brooksville and Miama, Fla.

Mr. E. C. Cotton, who for several years has been chief of the State of Ohio Department of Agriculture, Division of Plant Industry, resigned on February 15, 1923. He has been succeeded by Mr. Richard Faxon.

Dr. W. M. Mann of the Bureau of Entomology is making a special investigation of the fruit fly situation in Mexico for the Federal Horticultural Board. He left Washington early in January and entered Mexico at Nogales, Arizona.

The West Indian Fruit Fly, *Anastrepha fraterculus* Weid., was intercepted by Messrs. E. Kostal and J. W. O'Brien, inspectors at the port of New York City, in mangos from Jamaica on ten occasions during the months of January and February.

Mr. Clyde P. Trotter, who has had about two years' experience in the inspection work on the Mexican border, as well as about eight months' experience in maritime inspection work in New Orleans, La., was recently transferred to Galveston, Texas, to take charge of the work of the Federal Horticultural Board at that port.

Mr. R. D. Kennedy, Inspector of the Federal Horticultural Board in Washington, D. C., recently collected what appears to be *Aspidiotus cryptoxanthus* Ckll., on walnut cuttings, and *Lepidosaphes flava* var. *hawaiiensis* (Mask.) on chestnut cuttings from Shantung, China. Neither of these Coccids are known to occur in the United States.

Egg masses of the gipsy moth, *Porthetria dispar* L., were intercepted during the month of January by Mr. Max Kisliuk, Jr., in charge of the Board's activities at Philadelphia, in cracks and openings of sheet cork which arrived from Bordeaux, France. This is a very fortunate interception and indicates another avenue for the entry of this pest.

The State of California Department of Agriculture has recently issued Quarantine Order No. 41 which relates to Citrus White Flies. This Order supersedes Quarantine Orders Nos. 15, 18 and 21, and is applicable to the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisana and Texas. Copies of this Order should be in the possession of the inspectors of the states enumerated.

Mr. Heber J. Webb, Crops and Pests Inspector of Utah, reports that Easter lily bulbs, which were imported from Japan in November, 1922, are now showing serious injury as a result of the presence of *Rhizoglyphus hyacinthi* Boisd. He reports that about thirty per cent of the bulbs failed to grow, and many of the seventy per cent. which grew produced inferior plants which were worthless from a commercial standpoint.

Inspector Ryan of the Entomological Branch, Canadian Department of Agriculture, has continued his investigations on the possibility of spreading the European Corn Borer in shipments of live stock. He found that corn on the cob was often fed to hogs en route to the stock yards. On arrival at Toronto the cars were cleaned, and manure sold to a contractor. The latter shipped the manure to different points.

On account of the serious shortage of broom corn in the United States which may necessitate Canadian broom manufacturers buying their supply in other countries, it has been necessary for the Destructive Insect and Pest Act Advisory Board to advise all broom manufacturers in Canada that shipments of broom corn from countries other than the United States will have to be routed via an United States port for sterilization as there are no facilities for treating such shipments at Canadian seaports.

Larvae of the Pink Bollworm, *Pectinophora gossypiella* Saund., have been found in cotton seed arriving on the Texas border as follows: at Eagle Pass one interception was made by Mr. R. B. Haller; at El Paso larvae were taken by Mr. T. A. Arnold, and a second interception was made by Mr. J. M. Singleton. Two of the above inspectors, namely Messrs. Arnold and Singleton, have also intercepted the Avocado Weevil, *Heilipus lauri* Boh., in avocados arriving from the interior of Mexico on two occasions. In each instance the avocados were in the possession of passengers.

Information has been received from Dr. S. B. Fracker of Wisconsin to the effect that a bill is under consideration in Wisconsin which would provide for the examination and licensing of all individuals or firms applying insecticides, pruning trees, and engaging in other activities along the lines of tree surgery and landscape architecture. The recent rapid increase in the amount of spraying carried on together with the effects of a sleet storm a year ago which required an unusual amount of tree trimming in large sections of the state have caused a popular demand for protection from incompetent workmen in these fields.

Mr. Harry B. Shaw, in charge of the work of the Federal Horticultural Board at New York City, reports that commercial shipments of Italian broom corn are arriving infested with larvae of the European Corn Borer, *Pyrausta nubilalis* Hbn. A careful examination of several bales contained in one of the shipments showed that ten per cent. of the stems bore evidence of borer injury and one-half of one per cent. exhibited larvae. These shipments, as a condition of entry, were sterilized with live steam. Mr. Shaw also reports that a small shipment of broom corn arrived in New York invoiced as buckwheat.

A recent shipment of twelve mango plants received by the U. S. Department of Agriculture from Brazil illustrates very forcibly the danger which accompanies the introduction of plants. Inspectors H. Y. Gouldman and W. T. Owrey, of the Federal Horticultural Board, found these plants to be infested with nine recognized species of scale insects, namely, *Chrysomphalus aonidum* (L.), *Chrysomphalus dictyospermi* (Morg.), *Ischnaspis longirostris* (Sign.), *Howardia biclavis* (Comst.), *Coccus viridis* (Green), *Pseudaonidia trilobitiformis* (Green), *Vinsonia stellifera* (Westw.), *Parlatoria proteus* (Curt.) and *Morganelli longispina* (Morg.). Two additional species were collected, but identifications have not been secured as yet. These plants were also infested with species of Aleurodids and Aphids, and in the soil around the roots were found Ants and Isopods.

Inspector Cameron, Entomological Branch, Canadian Department of Agriculture, attended the Ottawa Winter Fair on January 15-19 and examined all the exhibits of seed corn on cobs on exhibit. Mr. H. F. Hudson attended the Essex County Corn Show on January 15. He reported that the show was the largest on the continent this year and that there were at least a third more corn entries than at the International Show in Chicago. It is estimated that over a thousand bushels of seed corn were shown. Mr. Hudson also attended the Ontario Seed Corn Growers Show

Insect material collected on Manetti rose stocks from France.
(1) Nests of the Sorrel Cutworm, *Acronycta rumicis*, Linn. (2) Egg mass of *Mantis religiosa*, Linn. (3) Cocoons of *Calophasia lunula*, Hufn. (Natural Size).

which was held at Chatham, January 23-26. A total of 142 exhibits consisting of 9,556 ears were shown.

It is evident from reports received from State and Federal inspectors that foreign shipments of fruit and rose stocks are showing considerable infestation with insects which are not known to occur in this country. Infested shipments have arrived during the period January 1 to February 24, 1923, inclusive, as follows: pupae of the Dagger Moth (*Acronycta auricoma* Fab.) from France on fruit stocks, three times, rose stocks, once; nests of the Sorrel Cutworm, (*Acronycta rumicis* L.) from France on fruit stocks, four times; nests of the White Tree Pierid, (*Aporia crataegi* L.) from France on rose stocks, twice, and on pear and cherry seedlings, once; the Snagboring Emphytus (*Emphytus cinctus* L.), on rose stocks from England, eleven times, from France, five times, and from Holland, once; one egg mass of the European Tussock Moth, (*Orgyia antiqua* L.) was taken on pear seedlings from France. Doubtless other interceptions have been made, but have not been reported to Washington as yet. Plate 2 is reproduced for the benefit of those engaged in the examination of nursery stock. The insect material photographed was collected by Messrs. H. F. Dietz and D. C. Johnston. Similar material has been collected by Mr. E. N. Cory and assistants. Plate 3 in Volume 15, No. 1, of the JOURNAL, illustrates nests of the White Tree Pierid in comparison with those of the Brown-tail Moth.

Apicultural Notes

The winter meeting of the Connecticut Beekeepers Association was held in connection with the Mid-Winter Exposition at the State Armory, Hartford, on January 26.

Ontario is to have $15,000.00 for the suppression of brood diseases during 1923: $5,000.00 is reported to come from the Dominion Government and $10,000.00 from the Province of Ontario.

The Bureau of Entomology announces that a set of lantern slides on the anatomy of the honey bee with a lecture condensed from the bulletin by R. E. Snodgrass, is now available for the use of beekeepers' associations. Applications should be made through the county agricultural agents.

On February 7, Dr. E. F. Phillips gave a talk on beekeeping and the use of honey as a food over the broadcasting station of the St. Louis *Post-Dispatch* (KSD). Reports of the receipt of the message have been received from points in Texas, Louisiana, as far east as Buffalo, N. Y., and north to Madison, Wisconsin.

Meetings for beekeepers were held by Purdue University January 29 to February 1 and at Cornell University February 20 to 23, both meetings being well attended by beekeepers of the respective states. Dr. E. F. Phillips of the Bureau of Entomology and Mr. George S. Demuth, editor of *Gleanings in Bee Culture*, took active parts in both meetings.

According to *Gleanings in Bee Culture*, the dedication of the Miller Memorial Library of Apiculture will take place at the University of Wisconsin, Madison, Wis., August 13-18. It is expected that beekeepers from all over the United States and Canada will attend this meeting which will be held by the University of Wisconsin in co-operation with the Wisconsin State Beekeepers Association.

The two motion picture films on bee keeping prepared by the Bureau of Entomology and distributed through the Motion Picture Laboratory of the Department of Agriculture have had an enormous demand. The film showing the life history of the bee has been especially popular and it has been quite impossible for the Department to furnish the film to all persons requesting its use.

Dr. E. F. Phillips addressed a joint meeting of the Society of the Sigma Xi and the Biological Club of Purdue University, Lafayette, Indiana, on "Beekeeping Investigations" on the evening of February 1. He was scheduled to speak before the Ohio State Beekeepers Association, Columbus, Ohio, February 1-2, the American Honey Producers' League, St. Louis, Mo., February 6-9, and to give one of the Ludwig Lectures of the Philadelphia Academy of Natural Sciences at Philadelphia on the evening of April 2.

The American Honey Producers' League held its annual meeting in St. Louis on February 6-8. Important matters which were considered by the convention were color grades for extracted honey and the enforcement of the Act of Congress on August 31, 1922, prohibiting the importation of adult honey bees into the United States, except from countries in which the Secretary of Agriculture shall determine that no disease dangerous to adult honey bees exists. The League will issue a monthly bulletin to its membership during the coming year. Prof. H. F. Wilson was re-elected president and Dr. S. B. Fracker has been chosen as Secretary by the Executive Committee.

The collection of honeys made by the Bureau of Entomology last summer was sent to the annual meeting of the American Honey Producers' League in St. Louis in February; where it attracted much interest. The members of the League in attendance were asked to state individually where, in their opinions, the several color grades should be limited, as based on the samples submitted. There was naturally considerable difference of opinion but by averaging the decisions made individually and by further discussion an agreement was reached, representing the recommendations of the meeting for the establishment of grades. It is expected that in the near future the Bureau of Agricultural Economics of the Department of Agriculture will establish legal grades for this purpose, after which assistance will be given in the duplications of these color grades for the use of beekeepers and buyers of honey.

A conference regarding regulations for the importation of adult honey bees, under the act of August 31st, 1922, was held in the United States National Museum, March 12th. The conference, with Dr. Phillips as Chairman, considered and passed the regulations as submitted by the Department of Agriculture. Regulation 5 was amended to make it clearer that bees could be imported from Canada without restrictions under the law, and, in Section B, by the addition of a clause further safeguarding the introduction of queens from countries in which the Isle of Wight disease does not now exist.

The following men attended the hearing: Kenneth Hawkins, G. B. Lewis Company; R. B. Willson, New York; N. E. Phillips, Pennsylvania; C. L. Marlatt, Bureau of Entomology; E. A. Sherman, Solicitor of the Department; A. P. Sturtevant, Bureau of Entomology; T. K. Massey, State Inspector of West Virginia; G. C. Chase, a Wisconsin beekeeper and George Rea and Ernest N. Cory, representing the apicultural section of this association.

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Vol. 16 JUNE, 1923 No. 3

Proceedings of the Thirty-fifth Annual Meeting of the American Association of Economic Entomologists (*Continued*)

Morning session, Saturday, December 30, 1922

The session was called to order at 9 o'clock and two papers were presented on dusting with an aeroplane. At the conclusion, a joint session was held with the American Phytopathological Society.

President J. G. Sanders: The first paper will be given by Mr. J. S. Houser.

DUSTING TALL TREES BY AIRPLANE FOR LEAF EATING INSECTS

By J. S. Houser, *Wooster, Ohio*

Abstract

A thirty acre mixed woodland infested with canker worm, *Anisopteryx*, and a four acre catalpa grove infested with catalpa sphinx, *Ceratomia catalpae*, were dusted from an airplane with undiluted arsenate of lead. A satisfactory kill was obtained in both instances and further data as to best ways of manipulating the machine, etc., obtained. Trained observers who witnessed the trials were fully convinced the method is one of true merit and will prove distinctly useful in the future because of its extreme rapidity and because it may be utilized under conditions which prohibit the use of land going machines.

At the last annual meeting of the Association of Economic Entomologists, the writer reported the successful use of the airplane as an instrument for distributing poison dust on tall trees.

The present paper reports two additional tests made during the past summer, the first of which involved the treatment of a thirty acre mixed woodland at Cleveland, Ohio, for the control of canker worm

and the second pertained to the dusting of a four acre catalpa grove near Casstown, Ohio, moderately infested with the catalpa sphinx.

As in the work of 1921, that of the present season was done in co-operation with the United States Aviation Experimental Station at McCook Field, Dayton, Ohio, and it is a pleasure to again recognize the efficient, painstaking effort of all of the men of the Field who were in any way connected with the project. We were fortunate to again have the services of Lieut. J. A. Macready as pilot for the Cleveland test and of Mr. M. Dormoy to operate the hopper in both of the tests. In the absence of Lieut. Macready, Lieut. Moseley piloted the dusting plane for the Casstown test.

The same hopper for carrying and distributing the poison was used this year as last and the plane was of the same type, a Curtiss JN-6. In both tests this season a second plane accompanied the dusting plane for observation and photographic purposes.

The powder used was an undiluted, finely ground, flocculent type of arsenate of lead, which, according to our present standards, sticks fairly well in the dry form to foliage. However, there still remains considerable room for improvement of the adherent properties of the material and it would seem that researches having for their object the improvement of this property of the poison are much to be desired. Some trouble was experienced with the powder compacting in the hopper, particularly if the plane flew several miles through "bumpy" air after the hopper was filled. This, however, is a mechanical defect which could be overcome quite easily through the installation of a simple agitator.

The Cleveland Test

The woodland in which this work was done was a part of the J. L. Severance estate and is located some twelve to fifteen miles east of the center of Cleveland. It is almost square in shape with but slight topographical variations and covered approximately thirty acres. The trees were irregular both in size and spacing, varying in height from 20 to 65 feet. In some parts of the woods the stand was very thin while in others the taller trees were close together and beneath them was a dense growth of underbrush and low-growing shrubbery.

The native tree fauna of northern Ohio was fairly well represented in the plot, the predominating species being beech. Others represented were hard and soft maple, American elm, basswood, oaks of various species, ironwood, etc. The native undergrowth had been supplemented

with plantings of ferns, wild flowers, rhododendrons and other shrubs, a studied effort having been made to preserve the natural effect, rather than create an artificial atmosphere. The result is most pleasing and at the same time it had been made almost impossible to use liquid machines without doing serious damage by trampling the low growing plants.

The infestation of canker worm larvae was only moderately severe. In no part of the woodland in which we operated were the insects sufficiently plentiful to cause defoliation, though it is no uncommon thing in northern Ohio for woodlands to be stripped by this insect. There were, however, enough caterpillars to cause considerable mutilation of the leaves of the more susceptible species, such as, elms, linden and maple and thus furnish a fair basis for the experiment.

Object of the Test

The more important points under consideration in this test were as follows:—

1. To determine if cankerworms can be controlled successfully by dusting.

2. To determine whether the dust released above a dense woodland will penetrate through the foliage of the tree crowns to the undergrowth beneath, as well as to determine the degree to which the dust may be controlled when so applied.

3. To secure such data as possible pertaining to the general practicability and defects of this method of forest insect control.

Details of Applying the Dust

The Postal Landing Station and Hangars at the Glen Martin Field, some four miles distant from the Severance tract, were used as a base of operations.

On the afternoon of May 23, Lieut. Macready made a careful ground inspection of the woodland to be treated, and in passing it may be said that while a ground inspection previous to the act of application may not be essential, it undoubtedly is of considerable value to the pilot later on.

During the forenoon of the following day, May 24, approximately 325 lbs. of powder was distributed over the woodland. The meterological conditions were not very favorable, the chief unsatisfactory factor being a wind which not only changed direction occasionally but in velocity as well, the latter averaging about 12 to 15 miles per hour. This is too high when operating over an area as small as 30 acres.

For the most part the plane flew crosswise of the wind in order to

secure a satisfactory distribution of the powder and just as low as possible, perhaps averaging not more than 20 feet above the crowns of the taller trees. Although plans were made to secure the precise time taken in the liberation of the dust by stationing observers in different parts of the woodland, it was found impossible to do this accurately since the observers could not always see just when the hopper was opened and closed.

No dust was applied during the afternoon of May 24. In the early evening of that day, 7¼ hours after the last hopperful of poison had been distributed and before the lead had had a chance to "set" by dew, a violent rainstorm almost of the dimensions of a cloudburst occurred. The following morning intermittent showers fell until about 11 o'clock when the weather cleared and an additional 100 lbs. of the powder was applied to a section of the woods.

Behavior of the Dust When Released

The influence of the "slip stream" persisted some seconds after the dust was released and the white trail floated out behind the moving plane. Presently, however, this was lost and the wind floated the dust cloud over and through the trees. One of the most gratifying phases of the behavior of the dust was its power of penetration or what may be termed its "covering power." After the dust cloud was liberated over the woodland it gradually settled through the crowns of the trees or the upper canopy of foliage, and for a period of four minutes after the passage of the plane we were able to detect floating particles of it.

As a result of this comparatively long period, most excellent distribution was effected. Not only were the tree tops well covered, but the leaves of the underbrush as well. Even the leaves of plants growing under the double canopy of tree tops and underbrush were well covered, and it is the writer's belief that the distribution of the poison excelled that which might have been obtained by the use of liquid sprays.

Effect of the Poison on the Caterpillars

Following the dusting of May 24, when it will be recalled the work was discontinued at noon and a heavy rain fell 7¼ hours later, a large sheet 9 x 9 ft. was placed near an elm badly infested with the larvae. The caterpillars thus had but a few hours of feeding before the storm. The following morning we found 109 caterpillars on the sheet, many of which were dead but some still showed signs of life. The latter, 19 in

number, were collected and placed in a container with unpoisoned elm leaves. Nine recovered and ten died.

A considerable quantity of the dead caterpillars was taken from the sheet, tree trunks and nearby foliage and their bodies analyzed for arsenic by Mr. C. H. Hunt of the Ohio Experiment Station. Mr. Hunt found arsenic present in large quantities, thus precluding the idea that the caterpillars might have been killed by the storm or have died from "wilt" or other disease.

The final notes were taken May 31. Throughout the area which had received the double treatment, i. e., an additional dusting after the rain had washed off the first, the control of the caterpillars was almost perfect. It was difficult to find any living insects, and little additional injury seemed to have been done the foliage. In other words, the treatment seemed to have resulted in excellent commercial control. Since the foliage was damp at the time the poison was applied it "set" immediately and could be found as an excellent coating on leaves taken in all situations.

In the area which had not received the double treatment, there were still on May 31 some cankerworm larvae feeding and the injury to the foliage had progressed somewhat. The application, however, undoubtedly had been of value.

Incidental Results

An unanticipated aspect of airplane dusting was brought out in this test, viz: the consummate neatness of this method as compared with liquid spraying. With the latter there may be serious mutilation of choice plants by trampling of workmen, dragging of heavy hose and the passage of the machine. In many instances this is not a serious matter, but with property like the Severance estate, it is very important that expensive shrubbery, ferns, etc., be uninjured.

When treated by airplane, the only visible evidence of the work was a slight deposit of powder on the foliage which did not in the least disfigure even the most delicate plants and blossoms.

The Casstown Test

Because of lack of time but little of the detail of this test will be given. Briefly stated it consisted in the treatment of a 4-acre catalpa grove of 3500 trees averaging about 25 feet in height. The plot was somewhat in the shape of an L with a difference in elevation of perhaps 70 feet between the top of the stem and the foot.

A part of the grove was bordered by pastures, and a tall double row of maples formed a difficult hazard at one end.

A moderate infestation of the first brood of the catalpa sphinx was present and when the work was done the larvae were but ⅔ grown. At least 4/5 of the foliage was present, hence the leaf canopy was very dense.

Object of the Test

The problem was two fold. 1st: To determine if a single application directed against the first brood larvae would control the insect for the season. 2nd: To determine if the heavy leaf canopy would be penetrated by the dust cloud.

Details of Applying the Dust

The McCook landing field, 20 miles away, was used as a base to operate from. The applications were made June 15 with a gentle wind blowing 2 to 5 miles an hour almost lengthwise of the grove, the flights for the most part being made almost directly into the wind, and at an altitude of 40 to 50 feet directly above the trees.

Because of the height of flight and the narrowness of the grove it was estimated that only about one-half of the 200 lbs. of powder used was deposited on the trees.

An excellent distribution of the poison was procured except in the immediate vicinity of the bordering rows of tall maples and at the opposite end where the hopper was "cut off" too soon in order to prevent the dust falling on the pasture land.

However, with all our care, some poison fell on the pastures but it was found to be comparatively easy to remove this where the grass was short, by dragging over it a small, many branched tree. Where the grass was tall, we dragged over it a thirty foot pole with a heavy log chain looped behind. Both plans jarred the poison from the grass blades and deposited it on the ground beyond the reach of stock.

The Effect on the Caterpillars

The first ailing caterpillar was found 8 hours after the first charge of powder had been released and by 46 to 50 hours after the application of the poison the dead caterpillars were very abundant.

In brief the test was very successful—it destroyed the first brood of worms and prevented the appearance of a destructive second brood and effected a satisfactory commercial control of an outbreak of the catalpa

sphinx. In the two areas mentioned where it was not possible to secure a perfect application some caterpillars survived but these were not numerous enough to restock the grove for subsequent broods.

Some Defects of the Airplane Method of Dusting

As might be expected, with the seasons additional experience some defects in the general proposition of treating tall trees by airplane and in particular of the specific equipment which we used in the work have become apparent.

A general criticism which might be made of the proposition of airplane dusting as a whole is that it is difficult to determine the extent of the area covered by any single passage of the dusting plane, particularly when one is operating on a large woodland. It is hard to designate or mark the treated area so that spaces may not be missed or be double treated with the next passage of the plane.

This trouble would be at least partly and probably largely overcome if certain changes were made in the apparatus. As the installation is now constituted the complete attention of two men is required to liberate the dust. Had the man in the passenger cockpit any time to look about it is doubtful if he could see much because of the dense cloud of dust with which he is enveloped when the mechanism is in operation. If the distributing machinery could be driven by an electric or wind motor, the hopper centrally installed and the dust cloud released at the rudder rather than at the side of the cockpit, the vision of the observer would not be interferred with and he would be left free to note the distribution of the dust over the area under treatment.

It has been suggested to the writer that perhaps one man could pilot the plane and at the same time operate the liberating apparatus if such was mechanically driven but in this I do not agree. In my opinion the entire attention of the pilot is required in flying the ship just as low to the tree-tops as is possible—that the success of the operation depends upon at least moderately low flying and that the services of a second man are essential for operating the distributor and observing the area covered by the dust. The latter cannot be estimated, neither can it be observed from the ground in large wooded areas, and since distribution can be noted from the air only, it follows that either an observer must be in the dusting plane or a second plane must be used for observation purposes. Of the two plans, obviously the most practical is the first named.

Another criticism of the method may be made justly that appropriate

landing fields are not always accessible and that they are less likely to be accessible in the very areas where airplane spraying would be most practicable. With the development of aeronautics, however, not only will progress be made in the perfection of landing apparatus and methods but additional fields will be constructed for the accommodation of the public.

The final defect to which I wish to refer pertains to the type of plane and hopper used. It is the general opinion of those experienced in aviation matters who were connected with this test that the Curtiss JN-6 is not a suitable plane for this work. The writer will not attempt a detailed discussion of this matter but will state that the general opinion seems to prevail that a plane with larger carrying capacity and perhaps of an entirely different type of construction should be employed. It would seem that if a moderately slow plane capable of carrying two passengers and a minimum load of 500 pounds of powder could be had for the work it would much more nearly fill the requirements. This amount of poison should be sufficient for 30 to 50 acres of woodland, and thus it would be entirely practical to use a landing field even as far as 25 miles away if with each flight such an immense territory could be covered.

In addition to the substitution of a mechanically driven release instead of the hand apparatus as previously discussed, the hopper should be equipped for more rapid distribution—I should judge at least five times that of our present machine.

Conclusion

Each season we see some of the more notorious shade and forest insects steadily extending the area of infestation in the United States and at the present time a most serious situation exists in the apparently imminent invasion of some of the great wooded playgrounds of the land. Dusting by airplane at least offers a possible means of check and when one considers the degree of success which has attended the Ohio work it seems highly worth while that this method be given a thorough painstaking trial.

The writer will admit that at first thought the plan seems highly impracticable, but since the work of 1921 and during that of the present season many fellow workers have expressed the belief in no uncertain terms that the method seemed most thoroughly practicable and would stand the test of time. Almost all of the observers who have witnessed the Ohio trials have been highly skeptical before the work was done,

but after seeing with what unbelievable dispatch an area could be covered and with what neatness and thoroughness the treatment could be made, without exception they have become thoroughly converted to the idea.

The next paper will be presented by Mr. A. F. Burgess.

EXPERIMENTS IN DUSTING FOREST AREAS WITH AN AIRPLANE

By A. F. Burgess, *Melrose Highlands, Mass.*

(Paper withdrawn from publication)

Mr. W. E. Britton: I would like to ask if the gipsy moth caterpillars were killed by this method of dusting and whether the experiments will be continued.

Mr. A. F. Burgess: Owing to delay in securing the machine and the equipment, and the bad weather, the dust was applied rather late in the season, and the results showed no effective killing of gipsy moth caterpillars. Data secured was mainly on the distribution of the poison and the general utility of this method of work. At present I do not think it is a practical method in large forest areas. It is possible that the use of a dirigible or a very slow moving machine might be more effective, but the operation of an airplane in large forest areas is simply mechanical and lacks the element of thoroughness that you should have if you are going to do effective work.

Mr. J. M. Swaine: We hope to persuade our Air Service to carry on one or two experiments on a large scale next summer in Western Canada. It seems to me from all I can learn and the experience I have had in the Air Survey work, that the heavier than air machine is altogether too risky for large operations. How high were you flying?

Mr. A. F. Burgess: 50 to 100 feet above the tree tops and the nearest landing place was 12 miles away.

Mr. J. M. Swaine: We cannot get pilots from our Air Service to fly under such conditions. They will not take the chances. There is great danger and if your engine fails, a serious accident will result. Flying a few feet above the tree tops is altogether too risky. With a lighter than air machine you can fly more slowly and the work might be

done satisfactorily. We are going to do our best to try out this method next summer.

Mr. A. F. Burgess: The danger element, I think, has been overlooked to a great extent in connection with this work. I am told by aviators and by others who are well informed concerning aeroplanes, that in ordinary cross-country flying they keep away from forest areas, unless the machines are at a high altitude; that is because they are more apt to encounter bad air currents. I was very thankful when the experiment was over and no one was hurt. New England is recognized as a very bad country to fly in. It is rough and broken, rather heavily wooded, and favorable landing places are very scarce.

Mr. E. P. Felt: I hope something will be done along this line because it seems to me that if we are going to attempt to hold the gipsy moth in New York, it may be necessary to poison extensive wooded areas to the east. I believe the method ought to be tested thoroughly, probably with a lighter than air machine.

Mr. A. F. Burgess: This matter is under consideration and we hope to do something along that line another season.

Mr. J. S. Houser: In our consideration of this method we should remember that these are initial trials conducted with a primitive type of apparatus and without experience in the manipulation of the machine. It is unfair to pass judgment on its ultimate value by comparing it with our present day highly developed solid stream liquid machines which are the result of years of experiment and study. If we must make comparisons, let us compare this, the earliest aerial duster with the earlier types of liquid sprayers.

In the treatment of large forest areas, it is doubtful if it would be advisable to fly crosswise of the wind, but rather to head directly into the wind. The distribution of the powder thus would be much narrowed down and would permit one to fly much higher.

Another point is that we need a hopper with a much increased distributing capacity which would permit a sufficient degree of concentration even though one flew higher.

I know it is hazardous to fly low, but as I crossed the Berkshire Hills on my way to Boston, I wondered how it would be humanly possible to use a liquid sprayer under such very formidable conditions. Since the time seems near at hand when something must be done by way of insect control in this rough, broken area, does not the aeroplane duster offer more hope than any other method in sight at the present time?

It seems worth while that we extend every effort in exhausting this possibility.

Mr. D. F. Barnes: The relation of direction of flight to wind direction has been brought up. The area to be treated is a fixed factor; the wind direction variable, changing from hour to hour. If treatment of an area has been undertaken and a certain direction of the lines of flight established the only variations possible to compensate for changing winds are to vary the distances between the lines of flight or to change their direction. In a wooded area, with no distinctive features this is difficult. Either of the changes may give unequal distribution but the change in direction will, dountless, be more disturbing than the change in spacing. We know that the wind may vary as much as 180 degrees in an hour but in spite of that we must have even distribution of the poison if the insect is to be controlleed.

JOINT MEETING, AMERICAN PHYTOPATHOLOGICAL SOCIETY AND AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Professor E. C. Stackman, President of the American Phytopathological Society, called the meeting to order, and stated that the phytopathologists were very happy to meet again with the entomologists in joint session.

President E. C. Stackman: The first paper on the program will be presented by Mr. C. L. Marlatt.

THE WHEN AND WHY OF PLANT QUARANTINES

By C. L. Marlatt

Abstract

A review was given of important legislation in different countries of the world in relation to plant pests. After brief reference to the existence of ancient legislation, an account was given of the European legislation with respect to the Phylloxera, culminating in the Bern Convention of 1881, and with respect to the potato beetle, dating from 1875 when this pest obtained its first foothold in Germany. Other European embargoes were also discussed, such as that of Great Britain, on account of certain gooseberry and currant diseases.

A sketch of similar legislation in the United States was given, beginning with an account of the grasshopper laws of the late 70's, enacted by the States of Kansas, Missouri, Minnesota and Nebraska. It was pointed out that California was probably the first State to undertake comprehensive legislation, in its law of 1881. A review was given of subsequent State legislation which involved up to 1895 only four States, in addition to those previously listed, namely, legislation by Washington, Oregon, Idaho, and Colorado, as indicated in a compilation in Bulletin No. 33 of the Bureau of Entomology. The compilation of State laws up to 1898 (Bulletin No. 13, new series, Bureau of Entomology), indicated that 15 States had at that time general legislation against insect pests, and that 8 States had foul brood legislation. The next edition of State laws (Bulletin No. 61, 1906) recorded legislation by practically all of the States of the Union. This tremendous increase of legislative activity resulted from the spread of the San Jose scale in the eastern States, and is the origin of most of the existing State laws and regulations governing movement of nursery stock, etc. Various European plant embargoes and other legislation on account of the San Jose Scale of the same period were described. Reference was also made to the considerable legislation which has resulted in the South on account of the boll weevil and more lately on account of the pink bollworm.

A brief history was given of the effort in 1897, on account of the San Jose scale, to secure national legislation, the main object being to safeguard the interstate movement of nursery stock, but making minor provision for inspection of imported stock at designated points of entry, or in lieu thereof for the acceptance of foreign certification. The reasons for the failure of this effort were pointed out and a brief discussion was given of the inception in January, 1909, and the final enactment August 20, 1912, of the present Federal Plant Quarantine Act.

Reference was made to the plant pest legislation participated in by many foreign countries, and particularly by the English and French Colonies, where the necessity existed, similar to that in the United States, for protection from the older centers of civilization. It was pointed out also that our own Plant Quarantine Act had resulted in complementary legislation providing for inspection and certification of exports by some 32 foreign countries.

President E. C. Stackman: The next paper is by Mr. W. A. Orton.

BIOLOGICAL BASIS OF FOREIGN PLANT QUARANTINES

By W. A. Orton, *Washington, D. C.*

(Withdrawn for publication in Phytopathology)

President E. C. Stackman: We will now listen to a paper by Mr. W. A. McCubbin.

FACTORS IN THE SUCCESS OF DOMESTIC QUARANTINES

By W. A. McCubbin, *Bureau Plant Industry, Harrisburg, Pa.*

Abstract

Four features of domestic quarantines are discussed—(1) The legal aspect involves consideration of an adequate basic law, a well organized and capable staff, and an emergency fund to meet sudden cases. (2) The quarantine should be given close attention by the scientist from the viewpoint of the administration. (3) In quarantine methods emphasis is placed on the need for extensive and intensive surveys at the outset, and for emergency research to provide a basis for a permanent policy. Stress is also laid on the need of well planned methods and adequate machinery and the importance of fairness and strictness in enforcement. The official in charge of enforcement should be a man of high ability. (4) The public judges quarantines on the fairness and reasonableness of the enforcement rather than on the severity of the restrictions. Quarantine measures are more easily enforced in populations with a high average intelligence and a well developed sense of public duty. After one successful quarantine experience in a district a second is accepted with less reluctance.

The time has probably arrived when it will pay us to take stock of the whole domestic quarantine situation, and from past successes and failures derive those lessons which will enable us to meet future problems with greater confidence. St. Augustine states that, "Out of our errors we make unto ourselves a ladder by which we climb." That there have been errors in the past we admit, but to keep a just perspective of the situation, the past successes must also be considered. And when the curtain is lifted and we see past accomplishment as a pitiful effort and past failures that appear inexcusable, let us not forget that what we see clearly in the glaring light of present day knowledge was carried out in the days of feeble candle power. Without underestimating the success or overestimating the failure let us rather proceed with judicial mind to examine them both for such help as they can give us for further effort.

It would make an attractive study to arrange all our internal quarantines in a proper classification and subject them to careful analysis, so

that from the charted results future action could be predicted with the certainty that one has in the extension of a known curve. Perhaps the material available is too fragmentary to respond successfully to such mathematical treatment; at any rate such an exhaustive study is beyond my present reach and I shall content myself with pointing out some features of domestic quarantines as they concern (1) the legal aspect of quarantines; (2) the viewpoint of the administration; (3) factors in the quarantine itself; and (4) the relation of the public to quarantines. If these features are afterward subjected to more detailed discussion the purpose of this paper will have been attained.

The Legal Side of Quarantines

In days gone by many difficulties were encountered in regulatory work because of the lack of full legal authority. These difficulties did not arise so much in connection with state functions which could be planned and arranged for long in advance, but rather in those cases where sudden action was necessary. In such cases the state frequently found itself without power to stamp out a pest. This hampering situation gradually has been improved, at first by the granting of legal power for specific cases and latterly by the adoption of more general basic laws. At the present time the necessity of reserve power to be used in an emergency is so generally recognized, that in one form or another blanket power for establishing quarantines exists in nearly every state.

Under our form of government it has always been considered dangerous to place arbitrary power in one man's hands, except for the performance of a specific and definitely limited act, and the idea of a blanket law granting a wide range of power to be applied at the discretion of some official, met with great opposition. But the awkward situations that have developed and the increasing requirements for pest control have gradually weakened opposition to the basic law plan, until the principle may be said to be now completely accepted. This change of viewpoint was made easier by a realization that quite adequate checks on the unwise or unjust use of arbitrary authority easily may be provided. It is realized that officials are quite unlikely to jeopardize their position and personal reputation by unwise or unjust use of power; that restraints involving "third-party" boards or committees are satisfactory; and that the public itself carries in its million hands the final check of an implacable vote.

When compared with past conditions the present situation is gratifying. Our ideal of an ample basic quarantine power in each state is

fast being realized. Henceforward the crop protection watch dogs may be expected to roam free, ready at a moment's notice to deal with each unfriendly intruder, instead of being confined by the chain of inadequate legislation, at the end of which chain they could bark but not bite.

It should now be added that such a law can only function with full mobility, if it is entrusted to a well-trained and capable staff. The size of this force may vary for different conditions, but it should be so organized that, like a skeleton army, it can be promptly enlarged and extended in any direction to meet all sorts of emergencies. With a basic law and an efficient staff, there still remains one other feature to complete this trinity of legal factors. It is an emergency fund, without which the most faithful and energetic body in the world will be utterly helpless. This has always been a difficult matter to procure, and various administrations have solved it differently, when need arose unexpectedly. The makeshifts, subterfuges and juggling of finances that have been found necessary to meet emergencies are strong evidences that the setting aside of a definite emergency fund is a desirable thing to plan and work for in every state.

A great deal could be written on the legal bearing of numerous quarantine details. There might be considered for example, the wording of a quarantine so as to accord with, and keep within the authority of the basic law; the fixing of responsibility for violation; delimitation of areas so as to correspond to known political subdivisions or in some other simple manner easily verifiable; the position and legal status of employees, agents, and common carriers in respect to the quarantine; the delegation of authority to agents; the necessity for drawing up regulations so that they will include every type of situation that is likely to arise, will be clear to the public, and will exhibit that sweet quality of "reasonableness" so dear to the legal mind; the desirability of having these regulations so arranged that any violation can be established in a simple and definite way; of having them so worded that they and the violations of them will be easily understood by magistrate, judge, or jury; the necessity of having each indictment or information free from error and the evidence clear and incontrovertible; the question of whether violations shall be taken into court or regarded as cases of summary trial before a magistrate or justice of the peace.

While these and numerous other similar points are not properly the field of the scientist, yet they are the materials of which the quarantine fence is constructed. He who understands the purpose of such a fence

and can also supervise the building of it, is the more likely to have a barrier which is not only pest-proof but violation-proof.

The Quarantine and the Administration

A second phase of the quarantine question relates to the viewpoint of the administration. The board or official entrusted with the legal power to erect and enforce regulatory measures may be regarded as a Janus-headed individual, with one face toward the public and the other turned to his scientific staff. Naturally he will have an attitude of mind slightly different from that of the scientist, since of necessity he is compelled to think on both his fronts.

When a quarantine is considered in regard to any pest or disease the single track mind of the scientist runs thus: "We can keep this pest within bounds by applying a quarantine." The mental attitude of the administrator is, "Is it necessary to do this? Could a system of inspection be devised to take care of the stiuation? Would a campaign of education serve the purpose? Can we make the quarantine effective if it is applied? Will the results justify the expenditure of money, the disturbance of agriculture and trade, and interference with individual freedom?"

Past performances indicate that this Missourian attitude of mind may inevitably be expected from the administration; hence it is of vital importance that in the early stages of the problem its various factors be subjected to clear thinking and careful weighing, and that close study be made of the effects that are likely to follow upon the interjection of a new and disturbing force into the domain of public interest.

Factors for Success in Quarantine Methods

We may next turn to some features of the quarantine itself. Let us suppose that in a state where the legal authority and administrative functions have been amply provided for, a new insect or disease makes its appearance. Hasty observation indicates that the pest is likely to be important and that a quarantine is required. It would seem that under such conditions no difficulty could arise. But our past experiences show that in the placing of such a quarantine there are likely to be two points of weakness.

The first involves the extent of infestation. Until that is known with some accuracy a quarantine may be merely an empty gesture. It may be argued that in such cases a chance has to be taken, that the necessities of the situation demand immediate action even at the risk of seeming to

have done an unnceessary or inadequate thing. This is valid reasoning as far as it concerns the past; but since we are today endeavoring to look forward rather than backward it is more appropriate to think in terms of future plans than in criticism of what has been. From this viewpoint the constructive thought that suggests itself is the extreme importance of plant disease and insect surveys in connection with the incipient stages of quarantines. We might venture to mention some cases which illustrate this point. The White Pine Blister Rust exemplifies clearly one extreme. In 1917 the United States and the Canadian Government drew quarantine lines north and south through the prairie region, forbidding the passage westward across this line of materials likely to carry the disease. The object was to protect the western pine region from the Rust which at that time had not been found there. In 1921 and 1922 the disease was found widely spread in British Columbia and the adjacent State of Oregon. We cannot help seeing now that at the critical period adequate provision was not made for scouting the western area. Similarly in the case of the Mexican Bean Beetle an area including several counties was quarantined, but later on this insect was discovered in several other distant localities and the quarantine had to be abandoned. Many other like cases will occur to everyone who is familiar with the past records. Leaving out of our thought entirely any consideration of the policy or methods involved,may we not draw from these cases the clear lesson that scouting and survey work on both extensive and intensive scales are of the highest importance, and should be intimately correlated with quarantines, either before they are actually placed or as soon as possible thereafter.

During the last few years the survey situation has been vastly improved by the development and organization of special Federal agencies for survey work, and these have been correlated with State forces so as to function in an admirable manner. The methods and extent of the surveys in the Potato Wart problem, to mention only one of many, indicate the help that may be given to a quarantine problem by prompt and adequate surveys. The future holds promise that when a new pest or disease appears we shall be able to marshal forces large enough to locate the extent of the infestation with a promptness and accuracy that have not been possible in the past.

The second of the weaknesses referred to is the matter of what may be termed emergency research. When an economic pest appears we are suddenly confronted with the necessity for rapid decision, involving

one of four things,—eradication, isolation, control, or merely watchful waiting.

In making this decision we are first of all hampered by unfamiliarity with what is usually a foreign pest, and by our inability to foretell its possible capacity for damage; there are also our own human limitations to be considered. Given enough time the facts can be ascertained and the decision made, but many such problems are extremely urgent and deserve speedier solution than can be given by the leisurely work of one or two investigators who are too often young or inexperienced men. What such cases most need is "first-aid" research, the kind that gave Edison the incandescent lamp, the kind that builds a bridge out of a barb wire fence or patches a tire with spearmint.

When a decision of the kind referred to is required, we ought to be able to turn loose on it at once an energetic force with both the numbers and ability to get enough of the vital features of life history and habits to enable us to decide our future course. In the past, and to a large extent still, funds, organization, and perhaps we should add, generalship, have been inadequate for concentrated activities of this kind. But there is no reason why we may not plan for the future an organized method of bringing large-scale, intensive effort into action for the quick solution of emergency problems of this nature.

Going on from these weaknesses in the establishment of a quarantine, to the methods of the quarantine itself, there is one feature that deserves emphasis. It is the vast difference between a paper quarantine and a real one. However deeply a government official may reverence the grandeur of his own authority, unless he takes adequate means to enforce his promulgation only a few conscientious souls will pay any attention to it. It is perhaps going too far to say that no quarantine should be issued for which no provision is made for enforcement, but the truth of the matter is that *real* results from any quarantine are due to the watchful, active field man rather than the central office. To erect a quarantine without providing the machinery of enforcement is too much like trying to carry water in a sieve.

Of almost equal importance is the policy that the means and methods of enforcement shall be adequate to the desired end. To use a homely proverb one should not send a boy on a man's errand. This does not mean that all quarantines require the same rigid and absolute type of enforcement. In many cases complete isolation of a pest is impossible, or at least impracticable, and the only thing that can be done is to lessen or delay its spread. But whatever the degree of restriction aimed at,

the enforcement should observe the fourth rule of warfare which states,—"If a detachment is sent for a particular purpose enough should be sent to accomplish the mission." Lack of funds is and always has been our excuse for indifferent enforcement but it is worth consideration whether a less ambitious program for which adequate facilities are available would not in the end be a better policy than planning a man's work and sending a boy to do it.

Concerning quarantine regulations and their application it need only be said that, the simpler rules can be made the more easily they will be understood; and that if they are expressed as a prohibition of some definite act, the doing which may be easily established by witnesses, or by some "corpus delicti" of material evidence, they are more easily made the basis of prosecution. It goes without saying that such rules should be broad enough in scope to cover all kinds of cases, and should not discriminate between any individuals or groups. Finally if these regulations are not administered with fairness and impartiality the public is sure to get into such a frame of mind that the sooner the inspection staff is equipped with chain armor the better.

Nearly all successful quarantine work in the past has been successful largely because of the character of the official in direct charge of the details, and his staff. Program and organization may be good and funds sufficient, yet the results may be disappointing on account of the quality of enforcement. To be successful in directing a quarantine is a high tribute to ability, since this work calls for a man of no ordinary caliber. He must be well trained, energetic and faithful; he must possess good judgment and be resourceful in emergencies; be methodical, punctual and accurate; above all he must have a stout and rigid backbone and a tough skin tightly stuffed with sand; how can one expect such a man to be also tactful, gentle and courteous? Yet these sympathetic qualities are as necessary as the sterner ingredients if this work is to run smoothly. In short it takes a big man to enforce even a little quarantine. As this man is so should his assistants be, and if he is of the type mentioned, we can safely say, so will his assistants be.

The Quarantine and the Public

The reaction of the public to quarantines is a matter of much concern to us. Plant quarantines may be considered as belonging among the highest expressions of civilized life in that they involve a definite restriction or interference with individual liberty for the common good, not on moral grounds, not because of humanitarian considerations, but

on a purely economic basis. In this respect they are clearly related to the right of eminent domain and other similar functions of the state where a measure of liberty is withdrawn from the individual for the benefit of the public at large. Having a solely economic basis it is often somewhat more difficult to arouse the public to their support than where moral or humanitarian issues are involved. For in the threefold relationship which the public bears towards quarantines, it may be expected that those on whom the restrictions fall will be antagonistic and those whose interests are not affected either way will be indifferent, while to those who may be presumed to profit by the measure the benefits are usually too distant or intangible to stir much thought. But if any particular quarantine, or the quarantine idea in general, is to be successful, it is important to secure the backing of popular support both in the group which is benefited and among public spirited citizens outside this group.

The important feature for obtaining a favorable judgment from the public is after all the justness of the measure. Most quarantines are so simple in plan and so direct in method that when these are properly explained the average man accepts them as right and reasonable. With a program of popular education, news articles, and special efforts to reach those influential and public spirited elements in the community who have so much to do with molding general opinion, it ought not be difficult to awaken in the public an attitude of mind which may fall short of enthusiasm but which will at least guarantee intelligent acquiescence.

By way of parenthesis it may be noted that public interest, which always underlies support, is more easily roused in cases where the problem or the method of solution possesses what may be termed the dramatic quality. The White Pine Blister Rust has always been easy to get into the public ear, while appeals in prosaic cases like the Late Blight of potato, pass unheeded. In getting a quarantine before the public the use of whatever dramatic possibilities it may possess should not be overlooked.

It is not always a simple matter to create a favorable public sentiment, but it is terribly easy to destroy it. At best the public regards quarantines with mere toleration, as a necessary evil. This lukewarm favor can be alienated very quickly if there is negligence, unfairness, or discrimination in carrying out the work. Unless the rules and regulations are drawn so as to be reasonable and fair, and unless equality of treatment is rigidly accorded to all, public confidence will vanish like flax in a flame. The critical and all-seeing eye of the public

is ever alert for any glimpse of weakness or laxity, and standards of efficiency that might arouse little adverse comment in other administration affairs would here be subject to the bitterest condemnation.

A whole community will submit to fair and just restrictions with a few grumblings, but a falling down in enforcement so as to give the semblance of discrimination or favoritism rouses at once the wildest resentment. The public taste does not relish a quarantine diet, but when the dish is ordered they will eat it if it is well cooked and well served.

The type of population to which a restrictive measure applies is a feature that has to be taken into consideration. An intelligent progressive community which can understand the benefits to be obtained and in which the sense of public duty is well developed is obviously more likely to assume the necessary burden than an illiterate group which can not comprehend the beneficial aim and has but a feeble sense of social responsibility. Perhaps never in our quarantine efforts has there been a more extreme case in this respect than in the Pennsylvania Potato Wart Quarantine. This quarantine had to be applied to a population largely made up of diverse foreign elements all of which have low educational standards and show so little interest in public affairs that newspaper publicity is of small value. Ordinary methods would have failed entirely. The language obstacle, the mental inertia and the obstinacy of the ignorant here constituted a problem that has required the most patient, persistent and methodical work.

That this quarantine has been maintained with a strictness of enforcement rarely reached elsewhere, against the universal opposition of a large population and under the language and educational handicaps mentioned, is an accomplishment which inspires confidence in our future work. For a quarantine will seldom encounter such adverse conditions in any population with which it may have to deal.

Regulatory work has another phase in relation to the public. The success or weakness of each quarantine does not pertain to itself alone but has a definite effect on future efforts. A quarantine is a community experience; if the community memory of such an experience is that of a disagreeable task planned with care and carried out with thoroughness, fairness and tact, then the community will submit more readily to a second necessary restriction. But a few experiences associated with indefinite purpose, ill-considered plans, haphazard, irregular methods, and jarring personal contacts, will destroy to a large extent the valuable educational development which a series of quarantines should provide,

and which should make each succeeding measure easier to participate in for all concerned.

In conclusion I would present for further discussion a summary of the above mentioned factors that are concerned in the success of domestic quarantines.

(1) The desirability of a basic law providing ample power to deal with emergencies, whether these involve considerations of time or place or magnitude.

(2) For enforcement of this law there should be maintained ready for action a well-trained staff, not necessarily large, but so organized as to be readily extensible in any direction.

(3) An adequate emergency fund should be maintained for sudden use.

(4) Adequate survey work should be intimately and promptly correlated with every quarantine.

(5) Provision should be made for emergency research so that through extensive and intensive effort there may be quickly obtained data sufficient to form the basis of a permanent policy.

(6) The quarantine plan should include at the outset sufficient means, enough men and such careful methods that its success will be assured.

(7) Quarantine regulations should be simple, clear, and not discriminatory.

(8) The personnel of a quarantine staff is an important factor in its success; hence direction of this work should be entrusted only to men of outstanding ability.

(9) The public eventually judges a quarantine by the fairness, impartiality and thoroughness of enforcement rather than by the severity of the restrictions.

(10) Popular support is a valuable aid to success and to obtain it much effort of an educative kind is worth while.

An Exotic Coccid Taken in the United States. *Nipponorthezia ardisiae* Kuwana was taken in the nests of mound building ants by the writer near Rockville, Pa., on Feb. 14, 1921. Specimens were determined by Mr. Harold Morrison, U. S. Bureau of Entomology, Washington, D. C., who reports the scale as a native of Japan on the roots of *Ardisia japonica*. This represents a genus heretofore unknown on the North American continent.

F. W. Trimble

PRESIDENT E. C. STACKMAN: The next is a paper by Mr. Wilmon Newell.

TROPICAL AND SUB-TROPICAL QUARANTINES

(Summary)

By WILMON NEWELL, *Gainesville, Florida*

ABSTRACT

Quarantines to prevent the introduction of insect pests and plant diseases from foreign countries are of prime importance. The southern states are more vitally concerned with quarantine protection than are the northern states as insects have, in the South, a large number of host plants and control measures must be applied during a longer growng season. The Federal Horticultural Board is the mainstay of the country in the maintenance of effective quarantines and while its work has been invaluable and its accomplishments significant it is still far short of what it should be. Education of the public as to the importance of quarantine protection and more liberal appropriations for the work of the Federal Horticultural Board are urged.

Quarantines against foreign insect pests and plant diseases assume importance in proportion to (1) the degree of danger of their introduction and (2) the opportunities presented by existing conditions for the increase of, and damage by, any given insect or disease after its introduction and establishment.

Officials and residents of the interior states have not, as a rule, appreciated the importance of quarantine protection, perhaps on account of their not having had the opportunity to observe at first hand the numerous avenues through which pests may be introduced. Such quarantine protection is, however, of vital importance to the interior as well as the coastal states. Serious losses to the crops or fruits of one section of the country are, in the last analysis, felt by all. Destruction of the citrus fruit crop of California or Florida, for example, would be followed by a higher price to the consumer for apples, peaches and other fruits. Also, a pest established in one state finds many opportunities for spread to the other states.

The southern states are more vitally affected by introduced insect pests than any other portion of the country. This is true, not necessarily because an insect species, *per se*, is any more destructive under southern conditions than under northern ones—and this is a point which we do not concede—but because there is in the South a greater number of injurious species and the addition of each additional one but adds to the load which must be carried by the farmer and fruit grower; because the larger number of possible host plants increases the difficulty of applying control measures and because the longer growing season for crops makes necessary a greater expenditure and more continuous effort to maintain a

status of control. Whether plant diseases are more destructive in the South than in the North is a question which can best be answered by the phytopathologist.

As our experience with quarantines has been limited to Florida we can discuss them only from the standpoint of Florida's experience, but it seems safe to conclude that what applies in the case of Florida will also apply, in more or less degree, to all southern states.

The plant quarantine work in Florida was commenced in 1915 and since its inception has been conducted in close cooperation with the Federal Horticultural Board. Inspectors of the State Plant Board of Florida, engaged in quarantine work, hold appointments as collaborators of the Federal Horticultural Board and enforce the quarantine regulations of the latter Board as well as of the State Board.

In the case of some pests, the federal regulation is considered as amply sufficient but in other cases the federal regulations are supplemented by state regulations which, it is thought, add to the protection afforded to Florida alone. In still other instances the state maintains quarantines which are of importance to Florida only and which deal with insects or diseases of which the federal regulations do not take cognizance.

While the quarantines are intended to guard against the introduction of a very large number of foreign pests, the following may be mentioned as the most important:

The Mediterranean fruit fly (*Ceratitis capitata* (Wied.)) from Bermuda, Hawaii and other countries, the West Indian fruit fly (*Anastrepha fraterculus* (Wied.)) from the West Indies, Argentine, Brazil, Chili and other Central and South American countries, the Mexican orange maggot (*Anastrepha ludens* (Loew)) from Mexico, the pink bollworm (*Pectinophora gossypiella* (Saund.)) and the black fly (*Aleurocanthus woglumi* Ashby).

The amount of inspection work performed at the Florida ports from Dec. 13, 1915 to April 30, 1922, is summarized in the following table:

	1915-16	1916-17	1917-18	1918-19	1919-20	1920-21	1921-22	Total
Foreign vessels	166	1240	1777	1724	2458	3035	2255	12625
Total vessels	370	3257	4253	3485	4504	4948	4179	24996
No. packages received by boat, express, freight, mail, etc	500	3105	3422	69985*	336059¾	710413	1333333	2456817
No. packages returned	18	255	485	1521	4936½	2130½	2610	11596
No. packages destroyed	69	1182	1037½	1743¾	2345½	1564¼	1757	9678

*Prior to August 1, 1918, horticultural material inspected was reported by "shipments." A "shipment" might contain any number of packages. Subsequent to the above date reports were made of the number of packages or containers.

Space does not permit of listing the many insects intercepted in the course of this inspection work. In the case of Coccidae alone, the following species, either unknown or of very limited occurrence in the United States, may be mentioned: *Aspidiotus destructor* Sign., *A. fabernii* Houser, *A. palmae* Morg. & Ckll., *A. subsimilis* var. *anonae* Houser, *Asterolecanium miliaris* Bdv., *Lepidosaphes hawaiiensis* (Mask.), *Pseudaonidia articulatus* (Morg.), *P. tesserata* (DeC.), *Pseudischnaspis alienus* (Newst.), *Pseudococcus sacchari* (Ckll.), *Targionia hartii* (Ckll.), *T. sacchari* (Ckll.) and *Vinsonia stellifera* (Westw.).

Among the quarantines maintained by Florida to prevent the introduction of insects or diseases from other states may be mentioned those designed to prevent the introduction of citrus canker, brown rot of lemons and oranges, the Japanese camphor scale and the Mexican bean beetle.

A glance at the map of the United States here shown tells us immediately that the United States is not receiving adequate quarantine protection. We see that inspectors of the Federal Horticultural Board are stationed at Boston, New York, Philadelphia, Baltimore, Washington, New Orleans, Brownsville, Laredo, Eagle Pass, Del Rio, El Paso, Nogales, Calexico, Seattle and Portland, Oregon; also that collaborators of the Federal Horticultural Board are located at Newport News, Jacksonville, Miami, Key West, Tampa, Pensacola, San Diego, Los Angeles, San Piedro, San Francisco and Eureka but that the following ports are entirely without inspection service: Portland, (Maine,) Wilmington, Charleston, Savannah, Brunswick, Mobile, Gulfport, Galveston and Port Arthur. In other words, the quarantine fence around the United States consists of a few posts, with numerous gaps between. Surely such an arrangement falls far short of giving adequate protection. One has but to note the vast amount of dangerous plant material constantly arriving at any port of the United States to realize this.

No stigma attaches to the Federal Horticultural Board for this situation. To the full limit of its available resources, the Board's work has been thorough and efficient. The plain truth is that the Board has never had even reasonable financial support from Congress. When we recall that the great majority of the insects and diseases which occasion annual losses aggregating millions of dollars are introduced ones and when we recall our experience with such things as the Gipsy moth, white pine blister rust, Japanese beetle, Japanese camphor scale, citrus white fly and citrus canker, we can only marvel at the lack of foresight

being displayed by our national government in affording protection against more, and still more, of these destructive agencies.

The time has arrived when entomologists and phytopathologists should cease to regard the work of the Federal Horticultural Board as a mere routine activity. We have had too much of the "Let George Do It" attitude. Let us proceed without further delay to educate officials and citizens throughout the country to the importance of more adequate protection against foreign pests. This means that we must secure much greater support, morally and financially, for the Federal Horticultural Board.

President E. C. Stackman: Mr. Lee A. Strong is not here but has sent his paper, and a summary will be read.

WESTERN VIEWS ON PLANT QUARANTINE

By Lee A. Strong, *Sacramento, California*

Abstract

Quarantine power should only be invoked for the purpose of preventing the spread or introduction of a pest. When placed, a quarantine should be fairly and impartially enforced. To prohibit by proclamation does not prevent. Proper enforcement of a quarantine requires adequate enforcement machinery. The promulgation of a quarantine does not remove but apparently stimulates the desire to transport prohibited material. All carriers of plant products should be brought under regulation. Uniform quarantine action should be adopted by states and localities having common interests. Frequent meetings of quarantine officials with full discussion of mutual problems encourages equitable quarantine enforcement and tends to eliminate any spirit of retaliation. This has been demonstrated by the deliberations and actions of the Western Plant Quarantine Board.

It has been wisely said that no quarantine should be placed when inspection could with equal assurance, prevent the introduction of a pest. Once placed, a quarantine should be fairly and impartially enforced. Abuse of executive power will, sooner than any other factor, bring law enforcement into disrepute and jeopardize the entire fabric of laws designed and intended to be beneficial. The use of quarantine should not be invoked for its facility as an inspection measure, but for its value and necessity as a safety and protective measure. Another vital point in the placing of a plant quarantine is the importance of providing the proper and adequate machinery for prompt and full enforcement. Probably nothing has so materially weakened the support which should be accorded the general principles of plant quarantine as

the practice of issuing a prohibitive quarantine without making provision for compelling compliance with the prohibiting order. Too often the state entomologist or the state quarantine official writes a quarantine prohibiting the movement of a certain plant product out of a given district or into a given district, and then sits complacently in an office apparently either nursing the idea that the quarantine will automatically enforce itself, or placing an unjustified faith in human nature in the belief that in writing "Thou shalt not," he has effectively and finally dissipated any desire individuals or companies may have had to even attempt to move any article restricted by the quarantine. Plant quarantines are issued for the single purpose of preventing the introduction and spread of pests. They are necessarily placed because there is a desire to transport the particular plant products which are by the quarantine restricted in their movement. To prohibit the movement of a certain product in no wise discourages the desire to move the product! As a matter of fact, it often has the opposite effect and stimulates a desire to move the product even if it becomes necessary to resort to surreptitious methods to evade the quarantine and accomplish the purpose.

All these factors should be carefully considered before a quarantine is placed. If compliance with the regulations will be so burdensome on all agriculture as to cause the quarantine to be more burdensome than the pest quarantined against, then it is unquestionably wise not to use quarantine. In other words, the cure should not be made more deadly than the malady. California believes, and has believed for many years, in the wisdom, justice, and efficacy of plant quarantines. The Western States as a body believe in it, and the Federal Government believes in it. The effectiveness of a quarantine, however, as previously stated, depends entirely on the possibility of enforcement and the ability to realize the possibility. Quarantine enforcement in California has been made possible by the control of all shipments of plant products on arrival at points of destination. The state quarantine law provides that any person, persons, firm, or corporation who shall receive, bring, or cause to be brought into the state of California, any nursery stock, plants, trees, vines, shrubs, scions, buds, fruit, vegetables, or seed, shall, immediately after the arrival thereof, notify the State Department of Agriculture or Deputy Quarantine Officer or Quarantine Guardian of the district or county in which such nursery stock, etc., are received, of their arrival, and hold the same without unnecessarily moving the same or placing such articles where they may be harmful, for the immediate

inspection of such Director of Agriculture or Deputy Quarantine Officer or Guardian. This law places squarely upon the transportation companies at point of destination the responsibility of holding all plant products arriving in California until they have been properly inspected and passed. Naturally, the law does not contemplate the indefinite holding of perishable commodities; and the law assumes that the commodities shall and will be promptly and properly inspected and disposed of. It has been found that the interest of the transportation officials is equal only to the interest manifested by the quarantine officials. Inspections must be prompt. Calls must be frequently made to remind the transportation official of his duty. The same condition applies at post offices. Common carriers should not be subjected to restrictions not equally binding upon the Post Office Department.

In this connection, probably no carrying or transporting agency has shown a greater desire to cooperate in plant quarantine enforcement than the Post Office Department. That all states of the Union do not take full advantage of the opportunities afforded by the Post Office Department for inspection of plant products in the United States mails is to be regretted. While a degree of quarantine enforcement is in a certain measure desirable and effective, full and complete enforcement is in every way desirable, and certainly vastly more effective than a partial enforcement. It is also true that if common carriers are forced to comply with quarantine regulations while plants move freely and without hindrance in the way of inspection in the mails, it not only constitutes discrimination against common carriers, but encourages and assists in the defeat of the purposes of plant quarantine, since shippers and receivers of plant products will most assuredly forsake the common carriers for the less restrictive channels of the United States mails.

Of what real value is plant quarantine? Doctor Marlatt has repeatedly pointed out that our most serious pests have been introduced into the United States by incidental shipments of plants which were of no real economic value, and which should have been, and would have been excluded, had there been legal national authority for such action prior to the passage of the plant quarantine act. The fact that no pest of major importance has become established in the United States since the passage of the Plant Quarantine Act demonstrates in a graphic manner the value of plant quarantine to the United States as a nation.

As to the value of quarantine to a state, California has believed in the wisdom of quarantine action for many years, and by reason of judicious use of quarantine power, has succeeded in remaining free from many

pests now causing serious damage in other states and countries. Proof of the value of quarantine to California lies in the fact that, despite the favorable conditions in that state for pest establishment, the products of California, with one or two very minor exceptions, are accorded an unchallenged entry to the markets of the world. Believing that what is to the benefit of an individual state is beneficial to a group of states comprising a section where conditions are more or less similar, G. H. Hecke, Director of Agriculture of California, in 1919 called together the quarantine officers of the eleven western states, British Columbia, Hawaii, and the northern district of Lower California, and formed the Western Plant Quarantine Board. The object and purpose of this organization is set forth in clear terms in the constitution of the Board as follows:

> "It shall be the purpose of this organization to secure a greater mutual understanding, closer cooperation and uniformity of action for the efficient protection of our plant industries against plant disease and insect pests."

There is contained in that section of the constitution of the Western Plant Quarantine Board a declaration of the principles of the entire West, in so far as plant quarantine is concerned. This principle obligates any individual state to properly quarantine against pests within its own borders for the protection of another state and to enforce the quarantine with the same regularity and vigor as would be the case if the quarantine were directed against any other state. This is not only an action in good faith, but it is an action which in many cases keeps the markets open for plant products from non-infested portions of the state.

Quarantine officers of the West are greatly disturbed by the failure of eastern and some of the southern states to promulgate and enforce quarantines against serious pests which now exist in certain localities. Absence of quarantine action or lax enforcement of existing regulations causes every shipment of plant products not certified by the Federal authorities to be viewed and probably treated as an undesirable and dangerous importation. This suspicion exists not only in the minds of western quarantine officers, but in the minds of officials in at least a few states in other sections of the United States. The suspicion grows and finds expression in quarantine action proportionately as the value of plant quarantine is recognized and its principles adopted by individual states. It is a suspicion which should not be permitted to grow; it should be dissipated; it can be dissipated when the various states of the Union adopt proper plant quarantine practices.

PRESIDENT E. C. STACKMAN: The papers are now open for discussion.

PROFESSOR WETZELL: I have nothing to offer in the way of discussion, but would like to state that I have very good reasons for believing that the fireblight, *Bacillus amylovorus* is not a native of North America. I have considerable circumstantial evidence to prove that it is not. I hoped to have this ready for this meeting but have been unable to do so.

MR. R. KENT BEATTIE: Where does it come from?

PROFESSOR WETZELL: I have reason to believe it is Asiatic.

Adjournment, 12:30 p. m.

Afternoon session, Saturday, December 30, 1922

The meeting convened at 1:30 p. m., President Sanders presiding.

PRESIDENT J. G. SANDERS: The first paper will be presented by Mr. L. Haseman.

AMOUNT OF ARSENIC PLACED IN CALYX CUPS AND LETHAL DOSAGE FOR APPLE WORM

By L. HASEMAN, *Columbia, Mo.*

ABSTRACT

The original purpose of this investigation was to determine what type of spray nozzle and what pressure places the greatest quantity of arsenic in the lower calyx cup of apple blossoms for the control of the codling moth, *Carpocapsa pomonella.* The spray tests are made immediately following the dropping of the petals by using usually three nozzles each with three pressures. To determine the calyx content of arsenic a counted number of the small apples are collected from each of the test trees and the lower calyx cups with their arsenical content are carefully removed for chemical analysis. In this way it has been possible to determine the average arsenical content of the calyx cup of each apple from trees treated with different pressures and nozzles. These experiments show that a high pressure and coarse nozzle is less effective than a lower pressure with a nozzle throwing a finer mist. They also show that where the average calyx content of arsenic is the highest the percentage of calyx worms in picked apples is not always the lowest.

After determining the average quantity of arsenic placed in the calyx cups under good orchard management, the investigation was enlarged in order to determine whether or not this quantity of arsenic is sufficient to poison apple worms attempting to enter at the calyx end of the fruit. This called for careful laboratory tests to determine the lethal dosage for apple worms. Doses of powdered arsenate of lead varying from one millionth to five ten thousandths of a gram were fed to apple worms of varying stages of development. To administer these small doses one or more drops of distilled water with the dose in suspension were placed on bits of apple

which the worms consumed. These experiments show that for third instar apple worms and older ones, the lethal dosage is approximately five ten thousandths (.0005) of a gram of powdered arsenate of lead. This is practically the same as the average calyx cup content (.000521 grams) as shown from numerous orchard spray tests. It seems certain therefore that in good orchard spraying the lower calyx cup of each blossom hit squarely with the "Calyx Spray" will receive sufficient arsenic to poison the small apple worms which may attempt to enter the fruit at that point.

The writer began this study in 1909 under the direction of the late Professor Slingerland and continued it in 1910 under Professor Herrick. The original purpose was to determine what pressure and what type of nozzle placed the greatest amount of arsenical down in the calyx cups as protection against the later entrance of calyx worms. The first spray tests were made in the Farm Engineering Laboratory, Cornell University, where Professor Riley prepared special equipment to maintain absolutely constant pressures with each nozzle. The chemical analyses were made by Professor Cavenaugh of the Agricultural Chemistry Department.

On returning to the University of Missouri, the writer went into the orchard with the experiment in actual spray tests. As new or improved nozzles were brought out they were included in the tests. Except for a few years when frosts or funds prevented, the experiments have been repeated in the experiment station orchard at Columbia, Missouri each year since 1910. As the work progressed the original purpose of the study was expanded to include an accurate determination of the actual quantity of arsenic placed in each cup by each nozzle, and pressure used. Then the question arose, is this quantity sufficient to actually kill the codling moth larvae of different ages or sizes. This called for a laboratory test to determine the lethal dosage for apple worms. All chemical analyses have been made by members of the Agricultural Chemistry Department.

Plan of Procedure

Each year a block of apple trees including one or some seasons two standard Missouri varieties, Jonathan, Ben Davis and Missouri Pippin, has been set aside for these tests. These trees receive the first spring or clusterbud spray just the same as the rest of the orchard. When conditions are right for the calyx spray the experimental trees are sprayed by an experienced orchard man, being given a thorough treatment with the standard spray solution including one pound dry arsenate of lead and one and one-half gallons liquid lime sulfur in fifty gallons of water. A power sprayer maintaining reasonably constant pressures

is used. To avoid variation in strength of solution all tests each year are made from the same tank of spray solution kept agitated throughout the test. The later summer applications like the first are given to the entire orchard alike.

Usually three pressures, 75 pounds, 150 pounds, and 250 pounds have been used. The small Vermorell, disc, and Bordeaux nozzles and the spray gun have all been tested out.

In a few days after the calyx spray is applied a counted number of apples are collected from each of the experimental trees. Two hundred and fifty and five hundred apples are used for the tests to determine the quantity of arsenic in the calyx cup. For the calyx cup tests, the tip of each apple is pealed, and the sepals, exposed part of pistal and stamen bars removed and the calyx cup with a small part of the flesh at the tip of the young apple is then removed for later chemical tests. These are dried and later tested for total arsenical content of sample.

In the fall the crop from each tree is gathered and each apple carefully examined for every type of injury by insect or fungus disease, a separate record being kept of all calyx end worms.

Experimental Results

It is not the intention of the writer to insert here detailed tables with results of all the years tests but merely to include figures on the 1920 experiment which is one of the completest.

Table No. I.

Pressure	Nozzle	No. calyx cups	Weight of Sample	Percent arsenous Oxide	Total AS_2O_3	Quantity per Calyx	% Apples with calyx worms
250 lbs.	gun	450	4.7249	1.128	.05329	.0001184	3.63
" "	bordeaux	400	5.4703	1.353	.07401	.0001850	5.62
" "	disk	410	5.1671	1.006	.05198	.0001267	6.00
150 "	gun	450	5.4500	1.627	.08867	.0001970	1.92
" "	bordeaux	450	5.6576	1.013	.04718	.0001048	3.01
" "	disk	450	4.8520	1.249	.06060	.0001346	2.59
100 "	gun	250	2.8373	0.510	.01447	.0000578	9.25
" "	bordeaux	250	2.3250	1.433	.03331	.0001332	4.55
" "	disk	250	2.6520	2.660	.07054	.0002805	4.20

In this experiment the greatest quantity of arsenic per calyx cup wa deposited with the lower pressure, 100 pounds and the disc nozzles The spray gun with 150 pounds pressure and Bordeaux nozzle with 250. pounds pressure gave almost equal quantities but much less than the disc and 100 pounds pressure. The poorest results were secured with the spray gun at 100 pounds pressure. Except for the four above mentioned cases, the quantity of arsenic is practically the same in all the tests. A

glance at the records on calyx worms taken at picking time shows best results with 150 pounds pressure. The variety used throughout this test was Jonathan.

Determining the Lethal Dosage of Arsenic for Apple Worms

It is a recognized fact that with careful systematic spraying one can produce a crop with a very small percent of wormy fruits when checks show a very high percent of worms. The calyx spray properly applied may keep a crop of apples almost free from calyx-end-worms. This may properly be interpreted as meaning that the arsenic placed in the calyx cups is sufficient to poison worms attempting to enter the fruit at that point. To determine experimentally whether or not this is true, careful laboratory feeding experiments were made during the past fall. The dosage fed to the worms under experiments was carefully determined by first preparing in distilled water, solutions containing varying quantities of arsenate of lead. The solution used contained one gram dry arsenate of lead to 100, 400, 1600, 6250, 10,000, 15,000 and 1,000,000 cc. of water. Then after the solution to be used was thoroughly shaken to distribute the arsenate of lead evenly, one, or in some cases, two drops of the solution were dropped into a small cavity cut in a bit of apple. After slightly drying the treated bit of apple was then turned upside down over the worm in a small glass jar. In the majority of cases the worms at once set to work eating out the treated apple pulp, often leaving only a thin surface layer that usually dried so as to be unpalatable. In this way those worms which fed properly consumed the bulk of the treated pulp. By watching the worms, however, it was noted that some of the larger ones, that were not kept without food for a day or so just before making the tests, would cut off and discard bits of the surface treated pulp thus failing to consume the full dosage. The smaller hungry worms, however usually fed properly. This tendency on the part of some worms to discard bits of the treated pulp made it difficult to determine, just what part if not all, of the dosage was consumed in such cases. Repeated tests with careful examination to see just what was consumed are necessary in order to draw conclusions from feeding tests on the apple worms.

In these feeding tests no worms under the second or third instar were used. All specimens used were taken from infested apples. Careful breeding experiments carried out at Ithaca, New York in 1909 showed that usually the larvae are in the third instar before they eat down into the pulp. These experiments therefore deal with worms varying in age

from third instar larvae to full fed larvae. Later tests will be made to determine the lethal dosage for the young stage worms such as in nature are normally found feeding in the calyx end of the fruit. However, it may be safely assumed that a dosage that kills the worms beyond the second instar will certainly kill first instar larvae.

The following table shows the results secured by feeding larvae of varying sizes different quantities of arsenate of lead in determining the lethal dosage for larvae varying in age from the third instar to nearly mature larvae. In this work six different dosages were used varying from three and one-third millionths to five ten thousandths grams arsenate of lead.

Table No. II

Size of worms	No. worms	Dosage	No. days observed	Remarks
Very small	2	.00000333	2	Almost dead
One-fourth grown	1	.00000333	5	Almost dead
Very small	1	.00000333	4	Alive
Small	1	.000005	3	Dead
One-half grown	1	.000005	2	Dead
One-fourth grown	1	.000005	2	Nearly dead
One-half grown	1	.000005	2	Alive
½–⅔ grown	3	.000008	?	Alive
¼–⅓ grown	1	.0000312	4	Dose repeated. Dead
¼–⅓ grown	3	.0000312	6	Dose repeated. Dead.
One-fourth grown	1	.000125	4	Dead
One-fourth grown	3	.000125	4	Alive
⅓ to nearly grown	4	.000125	1	Alive
2 mm. long	1	.0005	2	Dead
½ grown	1	.0005	2	Dead
½–⅔ grown	2	.0005	2	Sluggish–had eaten little.
½–⅔ grown	1	.0005	1	Dead
Nearly mature	1	.0005	2	Alive–fed little.

This shows that for the smaller larvae a dosage of only three and one-third millionths grams arsenate of lead may kill but that some of the nearly mature worms which fed but little were not killed with a dosage of five ten thousandths gram. However, where feeding was heavy this dosage killed all worms and may safely be considered as a killing dosage for all stages from the third instar to practically mature worms.

Comparison of Lethal Dosage and Calyx Content

If the lethal dosage for the older larvae is five ten thousandths (.0005) grams arsenate of lead then this is most certainly more than sufficient for the caterpillars of the first two or three instars which are the size of caterpillars which feed in the calyx cups. A comparison of the lethal dosage with the calyx content will show whether or not our ordinary spraying method places sufficient poison in the calyx cups to kill the young worms.

The average of the nine above tests for calyx contents is .0001487

grams AS_2O_3. To reduce this to arsenate of lead we must multiply by 3.509[1] which gives .000521 grams arsenate of lead to the calyx cup. It is evident therefore that in our regular spray work we place on an average sufficient arsenate of lead in each calyx cup to poison even a full grown larva of the codling moth should it eat all of it. Such being the case then each calyx cup properly hit with the spray will receive enough poison to prevent the entrance of first, second or even third instar larvae.

Conclusions

These experiments show that:

1. In thorough orchard spraying a killing dosage of arsenate of lead for young apple worms is placed in the calyx cup.
2. A coarse spray under high pressure is not essential.
3. The spray gun with high pressure is effective.
4. The plats showing the greatest average calyx content had low tho not the very lowest calyx infestation at picking time.

President J. G. Sanders: The next paper is by Mr. O. I. Snapp.

RECENT DEVELOPMENTS IN PLUM CURCULIO INVESTIGATIONS IN GEORGIA

Oliver I. Snapp, *Entomologist, U. S. Bureau of Entomology, Fort Valley, Georgia*

Abstract

The establishment of the occurrence in the latitude of Central Georgia of two generations annually of the plum curculio, *Conotrachelus nenuphar*, and that a large percentage of the larvae injuring the best late varieties of peaches are larvae of the second generation were the most important truths revealed as a result of extensive investigations started in 1921. They followed the most severe outbreak of the plum curculio that has ever occurred in the South, when Georgia peach growers lost several million dollars from curculio damage. A third generation was carried through in the insectary in 1922. Picking up and destroying the small peaches that fell several weeks after the pollination season assisted greatly in correcting Georgia's abnormal curculio conditions, and is a wise supplementary control measure in latitudes where there are two generations of the insect. In one orchard a net saving of $5.25 per acre resulted from the operation. Discing to break up the pupal cells in the soil and burning over hibernating quarters during the winter months are other supplementary control measures that were successfully utilized. The investigations show that the ideal spraying or dusting schedule for the control of the plum curculio on peach in latitudes where there are two generations, consists of four treatments of arsenate of lead as follows: (1) Immediately after the petals fall; (2) When the fruit

[1]One pound arsenous oxide (AS_2O_3) will make 3.509 or 4.545 pounds of arsenate of lead depending upon process. Not knowing the formula of brand used the writer has used the smaller figure 3.509.

is exposed from the calyx; (3) two weeks after the second; and (4) four weeks before each variety is due to ripen. Four applications of lead is too much as an annual treatment for peach trees in the South. The four application schedule should be used when the curculio infestation is heavy, otherwise the lead in the third application should be omitted.

The severe outbreak of the plum curculio in the peach belt of Georgia during the season of 1920, which resulted in a loss of over two million dollars to the peach growers of that district, brought about the establishment of the Peach Pest Laboratory at Fort Valley, Georgia, and the inauguration of extensive investigations dealing with the life history and control of the insect. During the two years that this work has been under way some very important discoveries have been made in the life history of the pest, and a great amount of valuable data has been obtained on control measures. In order to make this paper as brief as possible it is my intention to develop only the most important results of this work, and to touch on the data that will be of most value to those working with the problem in other states.

The most important truth revealed as a result of these studies was the establishment as a scientific fact that in the latitude of Central Georgia there occurs annually two generations of the plum curculio, and that a high precentage of the larvae that renders the best late varieties of peaches unmerchantable in Georgia are larvae of the second generation. Furthermore, during the past season, I was successful in carrying through three generations, under normal conditions, at Fort Valley. The first adult of the third generation left the soil on October 7, the larva having left the fruit and entered the soil on September 11. Cool weather had set in before any of the third generation adults emerged, and a few days after their appearance from the soil they went into hibernation without the deposition of any eggs, or without showing any signs of copulation. Of course the third generation of the plum curculio is of very little importance in Georgia since the peach season is normally over there by August 1. The third generation was reared in the insectary in peach; late peaches being supplied, a few of which are grown by several growers in Central Georgia. These important discoveries, during the last two years, in the life history of an insect that has been referred to for nearly two centuries, and about which perhaps more has been written than any other American insect, are good illustrations of the probability that we still have a good many things to find out about even our best known insects. These interesting discoveries also indicate that the plum curculio should again be thoroughly studied throughout its range

of distribution, paying particular attention to the possible number of generations.

In planning the curculio suppression campaign, which has been so successful in Georgia for the two seasons following the heaviest curculio infestation that has perhaps ever occurred in this country, an effort was made to especially concentrate control measures on the first generation, because by so doing the size of the second generation, which is responsible for most of the "wormy" fruit of the desirable and profitable late commercial varieties in Georgia, would be correspondingly reduced. A great deal of stress was placed on the importance of picking up and destroying the small peaches that drop to the ground a few weeks after the pollination season. I am strongly of the opinion that this control measure did as much, if not more, to correct the abnormal curculio conditions in Georgia than anything that was done. This supplementary control measure was met with some opposition when it was first advocated two years ago, but the results accomplished from its utilization and the economy of the operation soon attracted the attention of the growers all over the peach belt and during the past season, when one of Central Georgia's best peach crops was produced, this control measure was enforced by at least ninety percent of the commercial growers.

Peach drop experiments conducted in Georgia show that an average of over fifty percent of the peaches that drop before May 5 are infested with curculio larvae. Repeated observations made during the past two seasons show that a majority of the peaches stung by the curculio shortly after the calyx is pushed off, fall to the ground. This is a result of the fruit being weakened by the work of the curculio, causing it to fall with other weakened fruit in Nature's system of thinning during the April drop. Consequently, the frequent destruction of the early drops prevents the development of countless numbers of the adults of the first generation, and this has a direct bearing on the reduction of the destructive second brood of larvae.

In order that some idea may be had as to the curculio infestation in peach drops in the South, and what could be accomplished by the picking up and destruction of this fruit, I will cite a part of the results of the peach drop experimental work conducted in Georgia during the 1921 and 1922 seasons. About four weeks after the falling of the petals in 1921 two and one-half bushels of drops were collected in an orchard near Fort Valley, and placed in shallow boxes fitted with wire mesh bottoms, under which were cloth trays for receiving the larvae. Each morning the larvae were counted and removed from the trays. At the end of

five weeks, when all larvae had reached maturity and left the fruit, our records showed that the two and one-half bushels of peach drops yielded 12,093 matured larvae. The adults that would have ultimately resulted from the infested drops in this orchard could have easily caused a heavy infestation in a 100,000 tree orchard by harvest time if uncontrolled.

This supplementary control measure of gathering up the drops was continued in this orchard each week during the season until the smaller fruits had stopped falling, and the spray schedule as recommended was carried through to the letter. The orchard was also disced several times for the destruction of first generation pupae about June 1. During the past season, 1922, two and one-half bushels of drops were again collected at approximately the same time as those in 1921, and placed in wire bottom boxes. After all larvae had left the fruit our records showed that the two and one-half bushels of drops this year gave only 2,752 larvae. The control measures enforced during the 1921 season were unquestionably largely responsible for this big reduction in the infestation.

The very small peaches that fall first are the ones that contain most of the larvae, and the percentage of infested drops decreases as the larger fruits fall. Under normal conditions it would not be economical for Southern peach growers to make more than three collections of drops, making the first soon after the shucks shed, and the other two at intervals of five or six days. Results of some recent experimental work along this line, where the drops were collected from a large orchard regularly every few days and placed in separate wire trays, showed that the first collection of drops, which was made shortly after the shucks had been pushed off, contained 62.6 percent of the larvae collected in dropped peaches in this orchard during the entire season. The second collection made five days later contained 16.7 percent of the larvae, the third collection 9 percent, the fourth 2 percent, and so on. Over one-half of the larvae were contained in the first fruit collected, and the first three collections gave over 88 percent. These figures substantiate the results of former experiments in that the bulk of the infestation in drops will be found in the smallest peaches that fall first.

The cost of this operation is surprisingly low. Much of the early opposition to this control measure was based on the fear that the expense would be too heavy. Actual figures obtained on the cost of picking up drops in both commercial and experimental orchards average two and one-tenth cents per tree for the three collections. In one

orchard five collections were made at a cost of two and nine-tenths cents per tree.

Some interesting figures were obtained from picking up drops in a Georgia Belle orchard containing 1394 trees. The orchard was divided equally into two parts, and care exercised in the division to avoid subjecting one side to a greater area of possible curculio hibernating quarters than the other. The drops were collected regularly every five or six days from one part, and on the other part they were allowed to remain on the ground under the trees throughout the season. Both parts were otherwise treated exactly alike. They received the spray applications consisting of the same materials on the same days, and the cultivation in each section was always done on the same day. At harvest the fruit from a number of trees in the center of each block was cut open to obtain the data on the curculio infestation. The results showed that there was one and one-tenth percent less wormy fruit in the part of this orchard from which drops had been regularly picked up and destroyed. This operation saved $74.25 worth of fruit from each thousand trees in this orchard. After deducting the cost of gathering the drops during the season there was a net saving of $52.85 per thousand trees. This would figure a net saving of around $5.25 per acre. The chief benefit, however, from the operation is that of preventing the development of myriads of adults, and thereby reducing the infestation of subsequent peach crops, which cannot be computed in definite dollars and cents.

We have found that the best way to dispose of peach drops is to bury them in a trench, covering them with a layer of quick lime and at least twelve inches of soil. Some growers burn their drops, but this is not very satisfactory on account of the water content of the fruit. Others have disposed of drops by throwing them into a pond or river. I doubt the expediency of this method of disposition, as we find that the curculio larva and pupa are able to keep alive on top of water for a considerable length of time.

When it became known that peaches were damaged in the South by more than one generation of the curculio, we gave a great deal of attention to a revision of the spraying and dusting schedules, so that the second brood of larvae, which is by far the most destructive one in the South, may be successfully controlled. A very important discovery in this connection has been made. We found that the adults leave their hibernating quarters and are on the trees in numbers by the time they are in full bloom. The adult curculio generally does a considerable amount of feeding before copulation or before egg deposition. They feed

greedily as soon as they leave their hibernating quarters, and this feeding usually takes place on the green succulent calyx which envelops the peach during the blooming period and for a week or ten days thereafter. Of course the plum curculio prefers the peach fruit to the calyx as food, but when the first meal is taken the peach is not exposed, it being entirely enveloped in the calyx. Observations on this habit of the plum curculio were first made in Mississippi during the 1920 peach season.

We have found that an application of lead arsenate immediately after the falling of the petals, so as to poison the calyces, kills off many adults as they appear from hibernation and before they have a chance to feed or deposit eggs in the small peaches. This early treatment of lead arsenate produces a marked reduction in the infestation in drops, which directly affects the size of the second brood of larvae by cutting down the number of first generation adults. A higher percentage of the set fruit reaches maturity when the early application is used, as the number of fruits that drop before maturity is greatly influenced by the number of peaches "stung" as soon as the shuck is off. Furthermore, the overwintering adults in some cases deposit eggs throughout the season, and this early application also lessens damage from these beetles. Spraying and dusting experiments conducted by the U. S. Department of Agriculture in cooperation with the Georgia State Board of Entomology during the past season show the curculio infestation in peach drops to be 25.7 percent where the first lead arsenate treatment was not made until the shucks were shedding, whereas the infestation in the drops on the plat that received the first treatment immediately after the falling of the petals was only 11.8 percent. The infestation of the drops from the check plat in this orchard was 43.1 percent.

Results from spraying and dusting experiments for several years have shown that an application of arsenate of lead about twenty-eight days before each variety is due to ripen, is the most important one for the second brood of larvae in latitudes where two generations of the plum curculio occur. Egg deposition by the plum curculio in the peach takes place during two distinct periods in the development of the fruit; namely, between the shedding of the shucks and the beginning of the stone hardening period, and during the ripening and swelling period. There are practically no eggs deposited while the stone of the peach is hardening, which usually starts about four weeks after the shucks fall and lasts until about four weeks before the fruit is ready to be harvested. Since some overwintering adults deposit eggs over a long period of time,

and since an application of lead arsenate applied before the stone hardening period will not protect it from the curculio during the ripening period, peach growers in latitudes where only one generation of the curculio occurs annually may also find a lead arsenate treatment four weeks before harvest of value. In Georgia last season 17 per cent of the peaches harvested from a large plat were "wormy" where the arsenate of lead treatment four weeks before harvest was omitted, whereas the infestation from a large plat where the lead arsenate final treatment was applied as the fruit entered the ripening period was only 1.8 percent. The check in this orchard gave 23 percent "wormy" peaches.

The ideal spraying or dusting schedule for the control of the plum curculio on peach in latitudes where there are two generations, consists of four treatments of arsenate of lead as follows: (1) immediately after the petals fall; (2) when the fruit is exposed from the calyx; (3) two weeks after the second; and (4) four weeks before each variety is due to ripen. This is the schedule that was recommended and so successfully used by the growers in Georgia during the past season, when one of the state's best peach crops was produced. The lead arsenate was used at the rate of four pounds of the powder to the 200 gallon tank. Four applications of lead arsenate at that strength is too much as an annual treatment for peach trees in the South. Some leaf margin burn resulted from the use of this schedule in a number of orchards in Georgia during the past season, and we expected it when the schedule was recommended. Every known method was being utilized to correct Georgia's abnormal curculio situation which was threatening the great peach industry in that state, and for that reason no hesitancy was made in recommending this schedule. No severe injury occurred from its use, however, in any orchard; and in any section of the South where the curculio infestation has been severe, or where it is expected to be bad this schedule mentioned cannot be improved upon and should be used. Its continued use year after year would perhaps eventually affect the productivity of the tree. Under normal curculio conditions in latitudes where two generations occur it would perhaps be better to omit the first or third application of the schedule mentioned, or make all four applications using three pounds of lead arsenate per 200 gallon tank instead of four pounds. These variations from the proven schedule, in order to reduce foliage burning, will be given special attention in the spraying and dusting experimental work in Georgia during the 1923 season.

A detailed account of other interesting facts brought out as a result of

these studies and investigations would make this paper too lengthy. I wish to mention, however, two other control measures that helped us to save the Georgia peach crop from the curculio. They are discing for pupae destruction, and burning over hibernating quarters during the winter months. Upon maturity of the plum curculio larva a cell is made in the soil where the pupal stage is passed. Some time is spent in preparing this cell, and usually the insect does not pass to the pupal stage for a week or more after it enters the soil as a larva. If these soil cells are broken, after the insect enters the pupal stage, the helpless pupa is soon killed by the pressure and heat of the soil. It had been found that these cells were nearly always made within the top two or three inches of soil. Consequently the use of an extension disc, which made possible the breaking up of the top soil under the spread of the branches where most of the pupation takes place, was strongly recommended during the latter part of May and the first two weeks in June. The orchards are usually worked a great deal anyway at this season of the year, and by the grower giving special attention to the discing under the trees many pupae were no doubt prevented from developing.

During the winter months all places near and adjoining peach orchards where the curculio might hibernate were burned over close to the ground. Fence rows and terrace rows were cleaned up, and rubbish piles and pruning heaps destroyed. Woodlands or wastelands adjoining peach orchards were burned over. We found that most of the hibernation in woodlands takes place within the first three hundred yards of a peach orchard, and growers were advised to go into wooded areas to that distance and brush back the rubbish with a pronged stick and light the windroll, allowing the fire to burn toward the orchard. In this way forest destruction was prevented by holding the fire in check. Jarring records showed a reduction of adult curculios in the Spring in orchards around which hibernating quarters had been burned over during the winter.

In connection with our life history studies at Fort Valley we jar a block of trees every other morning from the last of February until Fall. During the past season the control measures mentioned in this paper were enforced in the orchard used for this work, but were not fully carried out during the preceding season. The largest average catch of adult curculios in any one day from this orchard during the past season was 4.9 beetles per tree, whereas the catch on several days during the 1921 season reached 8.8 beetles per tree. There was almost a one hundred percent reduction in the curculio infestation in this

orchard during the past season, and the results here were fairly representative of those obtained in the majority of the commercial orchards in Central Georgia during the 1922 season.

President J. G. Sanders: We will now listen to a paper by C. A. Weigel and C. F. Doucette.

CONTROL OF THE STRAWBERRY ROOTWORM IN COMMERCIAL ROSEHOUSES

By C. A. Weigel and C. F. Doucette

Abstract

The results of three years' study of the seasonal and life histories of the strawberry rootworm (*Paria canella* Fab.) under greenhouse conditions, are briefly reviewed as a basis in formulating an effective control program. Due to the long period of egg-laying the maximum numbers of beetle are present in June and July. The second brood emerges during September and October.

The practice of replacing plants and soil at intervals of several years aids materially in ridding a house of these insects. Various control measures which have been tested in different localities on a commercial scale are discussed. A series of fumigations with hydrocyanic-acid gas during the drying-off period, using 2 ounces of sodium cyanid per 1,000 cubic feet of space with an exposure lasting 2 hours, killed 97 per cent of the beetles. (Muslin curtains proved effective in confining the gas in separate sections of open-range houses). In one establishment as many as 60,000 beetles were collected in a week by persistent handpicking. Keeping the foliage dusted with a mixture of 10 or 15 pounds of lead arsenate and 90 or 85 pounds of superfine sulphur from February to November, protected the plants and killed many beetles. Scraping a layer of soil 2 inches deep from the beds after the plants were cut-back at the end of the drying-off period removed many beetles. The cut-back plants were then sprayed with arsenate of lead at the rate of 4 pounds to 50 gallons of water to protect the breaking eyes. Filming the surface of the water, which remains on the beds after syringing, with kerosene-nicotine oleate killed many beetles. A layer of wood ashes and tobacco dust on the beds operated to some extent against the larvae and pupae in the soil. Composting soil for several months or sterilizing before it is used in beds aids in keeping a greenhouse free from infestation.

The attention of entomologists has already been directed to the depredations of the strawberry rootworm on greenhouse roses by papers which were presented at two previous meetings of this society. The first article[1] dealt with the early reports received by the Bureau of Entomology regarding its injury to rose and presented the results of some preliminary control experiments. The next paper[2] described the

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[1]C. A. Weigel and E. L. Chambers, Jour. Econ. Ent. April 1920, V. 13, no. 2, pp. 226-231.

[2]C. A. Weigel and C. F. Doucette, Jour. Econ. Ent. June 1922, V. 15, no. 3, pp. 204-209.

progress of the life history studies and experimental control measures. The following account is a summary of the results of the control measures which have been employed in commercial greenhouses and which proved effective.

It is thought desirable to review briefly the seasonal and life history of the insect under greenhouse conditions. The duration of the several stages are as follows: The egg stage varies from 7 to 15 days, the larva from 35 to 60 days, the pupa from 8 to 13 days, and the adult from about 70 to 100 days or more. One female lived for 364 days after emergence. During the winter months the adults remain in hiding in dead leaves or in the mulch and are seen only occasionally. About the middle of February they can be found more frequently feeding on the plants.

Egg laying commences about the first of March and continues through April and in some cases May and June. The larva and pupa stages are spent in the soil where the larvae feed on the roots of the plants. The first individuals of the new brood of adults begin to appear in May and because of the long period of egg-laying the number of beetles steadily increases, reaching its maximum in June and July. Soon after their emergence these adults deposit eggs and a second brood appears in September and October, the adults of which, however, do not lay eggs until the following spring. They feed voraciously for a time and then conceal themselves until the following February, occasionally coming out on warm clear days during the winter and feed to some extent on the green foliage.

Before discussing control measures carried out in individual establishments, mention should be made of the fact that it is a practice among rose growers to replace the plants and soil at intervals of several years. Without doubt this operation results in ridding a house of the insects provided it is done thoroughly and no beds are allowed to remain as sources of infestation. In the subsequent experiments to be discussed, the removal of plants and soil helped materially in reducing the severity of the infestation.

Investigation of the reported infestation at Alexandria, Va., in 1919 revealed the seriousness of the injury and the necessity for drastic control measures. Fumigation with hydrocyanic-acid gas using 2 ounces of sodium cyanid to each 1,000 cubic feet of space with an exposure to the gas lasting two hours, resulted in a 97 per cent mortality of all beetles above ground. The plants had been sprayed with arsenicals so that the surviving beetles found little green foliage to feed upon.

The next spring a light infestation was still evident but the replacing of all the plants during the summer ended the depredations and there has been no recurrence of the insects since that time.

A very heavy infestation was encountered in a large establishment of 250,000 plants at North Wales, Pennsylvania. The vast number of beetles present during the summer of 1919 was shown by the payroll for several school boys, who collected as many as 60,000 beetles in one week, at a cost of $150.00, or 25 cents per hundred beetles, and gathered several hundred thousand more during the subsequent period in which they were employed. While this practice destroyed many of the insects, nevertheless a large number escaped collection. A dust mixture containing 10 parts arsenate of lead, 40 parts air-slaked lime, and 50 parts sulphur was applied regularly throughout the summer of 1920. This was the only control measure followed that year, and in 1921 the injury done by the few beetles present was negligible. The reduction of this infestation was aided materially by the "tearing-out" during the winter of 1920–1921 of the more heavily infested sections in several houses, and incidentally by the collapse and subsequent rebuilding of the most severely infested house in February 1920.

Treatment of a heavy infestation at Roelofs, Pennsylvania, was started in 1920. The "tearing-out" of some sections helped only partially in the control since some heavily infested beds were allowed to remain and the beetles from them spread to the new plants. A dust mixture made up of arsenate of lead 10 parts, and sulphur 90 parts, was applied regularly during the summer and autumn of 1920 and the spring of 1921. The infested houses were fumigated once during the "drying-off" period in 1920 with hydrocyanic-acid gas at the rate of 2 ounces sodium cyanid per 1,000 cubic feet of space. During September and October 1920 the beds were watered heavily and the surface of the pools and puddles filmed with kerosene nicotine oleate,[1] using 1 pint of stock solution to 4 gallons of water. This was found to kill all beetles which came in contact with it while struggling in the water. Only a few scattered beetles could be found in several examinations in 1921. Dusting was continued throughout 1921 and also 1922 as a precautionary measure, and the infestation during July and August 1922 was negligible.

In a greenhouse at Oak Lane, Pennsylvania, 35,000 rose plants had suffered severe injury during 1919, 1920, and 1921. About two-thirds of the beds were replanted in the spring of 1921 but the infesta-

[1]Dr. Wm. Moore, Jour. Econ. Ent., June 1918, Vol. II, no. 3, pp. 341-342.

tion was very heavy on the older plants that fall. The only measure aimed directly at control was a practice of the workmen to collect and kill all beetles which would crawl up the wire stakes after every syringing of the plants. This was done regularly during September, October, and November in 1921, and on some days over a thousand beetles were collected and killed in an hour. The beds were kept immaculately clean and free from dead leaves and trash, and manure water was applied instead of mulching the beds. Only a few beetles could be found here and there during 1922.

A more intensive program than any of the preceding ones was carried on in an open-range of infested houses containing 40,000 plants at Doylestown, Pennsylvania. Sections of this place had been infested in 1919 and 1920, but during 1921 the whole range with the exception of about 8,000 new plants was overrun by the beetles. An average of 15 beetles to each plant in the badly infested houses is a conservative estimate of the numbers present during June and July.

The injury was so severe that it became impossible to produce salable flowers and the grower was obliged to stop his shipments to the markets. A series of fumigations with hydrocyanic-acid gas, as described in last year's paper, was employed during the month of July while the plants were being "dried-off." During these treatments the use of muslin curtains to separate sections of the open range proved satisfactory in confining the gas. The fumigations were quite successful for many dead beetles were found lying on the leaves and ground afterwards. After the plants were "cut-back" the surface layer of soil was scraped from the beds and in this removed material an average of three or four beetles per plant was found. The cut-back plants were sprayed with arsenate of lead at the rate of 4 pounds to 50 gallons of water to protect the swelling and breaking "eyes" as the florist terms the developing buds. As new foliage formed it was kept continually coated with a dust mixture containing 15 parts of calcium arsenate, 80 parts of sulphur, and 5 parts of powdered sugar. The dust applications were continued until the middle of November and were resumed in February 1922. About 1500 pounds of dust were used during the fall of 1921.

Starting in February 1922, wood ashes and tobacco dust were applied to the soil alternately at frequent intervals during the spring. Two carloads of each material were used. The absence of beetles at all times during 1922 has been in marked contrast with the large numbers present the preceding summer. Although a few beetles have been found occasionally, many searches lasting two or three hours have

succeeded in locating only five or six adults, and this condition prevailed throughout the year.

What do these commercial tests show? They have demonstrated that tearing-out the plants was of considerable importance in the reduction of all infestations; that fumigation with hydrocyanic-acid gas at the rate of 2 ounces of sodium cyanid per 1,000 cubic feet was used successfully during the drying-off period to kill the adults above the ground; that a persistent campaign of handpicking aided materially in getting rid of many beetles; that the regular use of an arsenical dust to keep the plants coated during the whole time when the adults were present was of prime importance in controlling them; that a dry mixture consisting of 10 or 15 pounds of either arsenate of lead or calcium arsenate, and 90 or 85 pounds of sulphur gave effective results; and that some of the other measures, such as scraping the soil surface, spraying the cut-back plants and applying tobacco dust and wood ashes on the soil to help combat the larvae and pupae, also have their places in an effective control program.

The following recommendations for control are based on the life history of the insect, and are applicable with the regular cultural practices. During the summer months the paramount consideration is to protect the plants from immediate as well as future injury. This may be accomplished by fumigation during the drying-off period to kill as many adults as possible, by scraping the surface soil from the bed when the plants are cut-back, and then spraying them with arsenate of lead or calcium arsenate using 4 pounds to 50 gallons of water to protect the swelling "eyes" from the further depredations of the beetles. During September, October, and November, eradication should be the florists' aim, because the beetles are still emerging and feed voraciously for some time. Every effort should therefore be directed toward ridding the houses of as many beetles as possible in order to prevent a recurrence of an infestation the following spring. During this period dusting must be very thorough and continuous in order to keep the foliage coated with the poison. Hydrocyanic-acid gas, however, cannot be used at this time at a killing strength without causing severe injury to the plants. Two or more treatments by filming the surface water of the bed with kerosene nicotine oleate may then be most effectively used to kill many of the adults. Beginning about the middle of February the plants must be kept coated with dust to poison any adults which may come out of hiding to resume feeding, and the soil in the beds should be kept covered with tobacco dust until "drying-off" time with occasional applications

of wood ashes at monthly intervals. These two materials will operate to some extent against the larvae and pupae in the soil and the tobacco dust will kill any newly hatched larvae which come in contact with it while crawling on or entering the soil.

To prevent an infestation from becoming established in a greenhouse, plants should not be retained in greenhouses longer than three years. In addition, cleanliness, involving the removal of dead leaves and trash, must be practiced incessantly, and soil which is used in the beds should either be sterilized or composted for several months before being brought into the houses.

From the preceding recommendations it is evident that no single practice or control measure will subdue this pest, and that successful control entails a program of several measures persistently followed and applied in such a manner that it will fit in with the normal cultural conditions under which roses are grown.

President J. G. Sanders: Mr. George A. Dean will present the next paper.

ANOTHER STEP IN THE CONTROL OF THE HESSIAN FLY[1]

By George A. Dean, *Entomologist, Kansas State Agricultural College*

Abstract

The Hessian fly, *Phytophaga destructor* Say, can be controlled very effectively in Kansas by early, deep plowing of the stubble, by destruction of volunteer wheat, delayed sowing and cooperative work along these lines. Observations show that the fly lives over in relatively small, low, moist springy places, usually of less than an acre though in some cases they may comprise 40-80 acres. The destruction of the fly in all such areas by turning under the stubble, keeping them free from volunteer wheat and restricting planting till after the fly-free-date is recommended.

During the last twelve years in Kansas, it has been demonstrated that the Hessian fly can be controlled very effectively by the following important steps: (1) Early, deep plowing of the stubble; (2) The proper preparation of the seed bed; (3) Destruction of the volunteer wheat; (4) Delay in sowing until the fly-free-date; and (5) Cooperation. Although we have been successful in controlling serious outbreaks of the fly, our methods of control have been primarily to terminate the outbreak rather than to prevent reinfestations, and thus it would seem that an important step in the control of the fly had been overlooked or neglected,

[1]Contribution No. 85, from the Entomological Laboratory, Kansas State Agricultural College. This paper embodies some of the results obtained in the prosecution of project No. 8 of the Agricultural Experiment Station.

because no definite conclusion had been reached as to the carry-over places or the source of the reinfestations. For a number of years it was thought that few Hessian flies remained throughout the wheat fields, and with favorable climatic conditions here they increased until there were sufficient numbers to cause serious damage or an outbreak which might extend over only two or three counties, or over the greater part of the entire wheat belt. However, in certain seasons, careful surveys and thorough examination of wheat plants failed to reveal any stage of the fly in the majority of the fields, and in fields where the fly was found it was usually in some isolated spot in the field, or some local area extending over a number of fields.

Observations and surveys extending over a period of twelve years have shown that the fly, during the years when there were no appreciable injuries, instead of living over in very limited numbers throughout the wheat fields, survived and bred in local areas that might be termed "reservoirs" or "carry-over areas." In general, these "reservoirs" consist of low, moist, springy places with a heavy soil. With the exception of the southeast portion of the state which has a considerable portion of low, swampy land, with a heavy soil and heavy rainfall, these infested areas usually consist of only an acre of two, although in several cases they may extend over an entire field of from 40 to 80 acres, and in a few instances they may consist of several square miles.

For instance, on the north side of Mill Creek in Wabaunsee County, there is an area about one mile wide and five miles long in which the Hessian fly has been found every year since 1911, and the farmers claim it had caused serious losses for several years previously. A control campaign was inaugurated on two farms in this district in 1913 with such good results that in 1914 the campaign was general over the entire area and the fly was brought under control.

However, the fly has been able to persist in this area and whenever wheat was sown early or volunteer wheat was allowed to grow, it became abundant. A survey of this area in November, 1921, failed to show any fly except in one field where a few acres had been planted early. This same area was visited again Sept. 29, 1922, and the Hessian fly eggs were so numerous on all volunteer wheat throughout the entire strip that it was necessary to destroy all the volunteer before planting.

About six miles west of McPherson there is a large area, locally known as "the basin," which is an old lake bed with very poor drainage. Our records show that fly has been found in this area practically every year since 1908. Again, southwest of Salina there is an area consisting of

from three to four square miles, which is very level, and poorly drained. Every year since 1911 this area has been inspected and always has revealed the fly. Also, two miles east of Haysville there is a field consisting of about 25 acres made up of low, sandy soil which retains the moisture much longer than the adjoining fields. This field was first visited by Messrs. Kelly and McColloch in 1913, and a careful examination showed that about 50 percent of all the plants were heavily infested. A small swale at the north end of the field had a still heavier infestation. Other fields in the vicinity were not infested. The infested field which was planted about Sept. 23rd, following wet weather, had been in wheat continuously since 1906 and was badly infested the previous year.

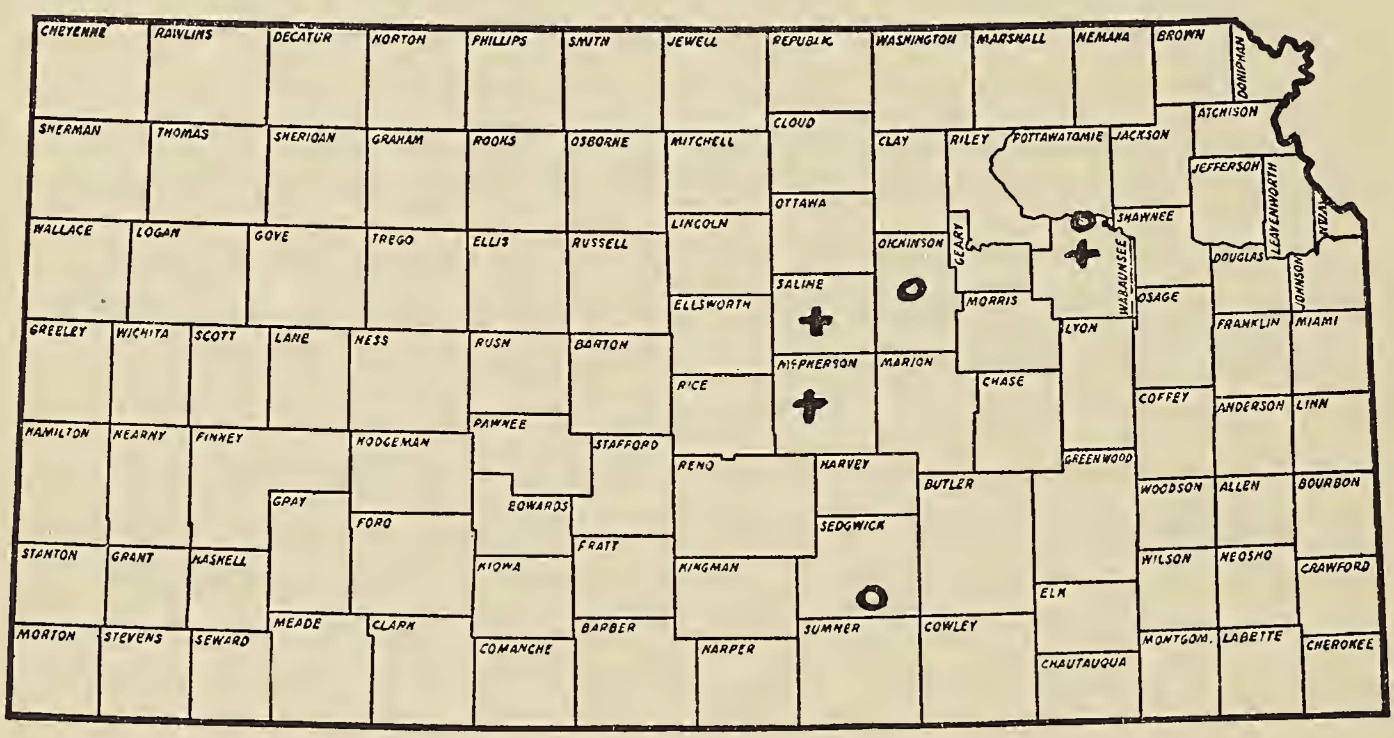

Fig. 3. Map of Kansas showing areas that have been infested continuously with Hessian fly for a period of from 10 to 12 years. + large areas. o small areas.

In order further to test this point, members of the Department of Entomology, in November, 1921, made a 60-mile circular trip east of Manhattan and examined every field of wheat for Hessian fly. The survey did not reveal a single fly, except in one field about 25 miles east of Manhattan. This field was so heavily infested that in some instances as many as 400 flaxseed were found in a single clump of wheat. The field consisting of low land, bordering on a small stream, had been

plowed early in the summer, but no attempt had been made to destroy the volunteer. The field was left for a spring crop. A survey around the field in September, 1922, showed the fly in large numbers and spreading to nearby fields of volunteer wheat.

In making Hessian fly surveys this fall, it was frequently noticed that the infestation was in small areas in the fields. Usually the field as a whole was free from fly, but here and there were spots consisting frequently of less than an acre where the fly was abundant. These spots were the lowest in the field and had many of the characteristics of the larger areas referred to above. In making a field survey last fall, emphasis was placed on these small areas and it was soon found that one could pick the infested places with a considerable degree of accuracy. On a trip from Manhattan to Salina, a distance of 74 miles, no fly was found except in the small, low spots in the fields. The same condition was found in a survey from Manhattan to Wamego, and from Manhattan to McFarland.

Careful surveys and observations during the past twelve years indicate that the fly is living over in these local areas or reservoirs, and from these areas is spreading or migrating into the main wheat fields whenever the soil conditions in them become similar to those of the local areas. If this is true, would it not be feasible or practicable to concentrate control methods on these local breeding places and thus prevent an outbreak? It would seem that it could be accomplished first by locating these places by careful surveys, and second by keeping them under careful observation. While one survey would probably serve for a period of several years, the observations of the areas after they are located should be made each year. In Kansas, the best machinery for making the surveys and keeping these reservoirs under observation would be the County Farm Agent, assisted or directed by the Extension Entomologist, and the Entomologist of the Experiment Station.

The fly in these local areas should be destroyed: (1) By turning under the stubble as early as the soil will permit of thorough deep plowing; (2) These places should then be kept clean of all volunteer wheat; (3) All wheat on these areas should be planted after the fly-free-date.

By practicing these methods over the greater portions of the principal wheat belt of Kansas, which can be done by utilizing the machinery we now have at our command, it seeems possible that outbreaks of the Hessian fly might be prevented.

President J. G. Sanders: We will now listen to a paper by Mr. D. J. Caffrey.

SUMMARY OF RESEARCH ACTIVITIES ON THE EUROPEAN CORN BORER

By D. J. Caffrey, *Arlington, Mass.*

(Withdrawn from publication)

President J. G. Sanders: The next paper is by Mr. H. T. Fernald.

CHARTING LIFE HISTORIES

By H. T. Fernald, *Amherst, Mass.*

(Withdrawn from publication)

President J. G. Sanders: We will now hear a paper by Mr. J. N. Summers.

A JAPANESE TACHINID PARASITE OF THE ORIENTAL MOTH, CNIDOCAMPA FLAVESCENS

By John N. Summers, *Melrose Highlands, Mass.*

The Oriental moth, a native of Japan, was accidentally imported and became established in the Dorchester section of Boston some time prior to 1906, as it was discovered there in numbers early that year.

Very little has been heard of it since until last year when it was found to be quite abundant in some portions of the infested area. This year it was also quite abundant and a scout of neighboring sections showed that there had been considerable spread since the last survey was made.

Last summer while in Japan studying natural control of the gipsy moth, my attention was called by Mr. J. L. King of the Japanese beetle laboratory at Yokohama to a Tachinid parasite of the Oriental moth which appeared to be quite effective in keeping it in check. A number of the adult Tachinids were reared and on my return to this country were sent to Dr. Aldrich for determination. He reported that they were specimens of *Chaetexorista pavana* B. & B. and that there were specimens at the museum from Japan which had been bred from the same host.

This Tachinid passes the winter as a puparium inside of the host cocoon with the remains of the host larva more or less surrounding it. The adults began to issue this year about the middle of June and continued to do so for nearly a month, moths and parasites coming out at

about the same time. The flies emerge by pushing off the lid at one end of the cocoon, the lid whose separation from the cocoon allows the escape of the adult moth.

Judging from reports and my own observations, this Tachinid is quite an effective enemy of the Oriental moth and it would be well worth importing and establishing, particularly in view of the increase of its host the last two years.

At the close of this paper, the final business was transacted, which is given in the report of the business session.

THE RESISTANCE OF WHEAT TO THE HESSIAN FLY—A PROGRESS REPORT[1]

By J. W. McColloch, *Associate Entomologist*, and S. C. Salmon, *Professor of Farm Crops, Kansas Agricultural Experiment Station*

Abstract

The study of the resistance of different varieties of wheat to the Hessian fly, *Phytophaga destructor* Say, has been under way for several years. The results discussed in the present paper show that resistance does occur in the field and that this resistance is fairly constant. Soft wheats, as a class, are more resistant than hard wheats. The cause of resistance has not been determined, but many factors have been eliminated. The evidence indicates that it is due to physiological causes and that silica is in some way associated with it.

In a previous paper,[2] the writers presented a preliminary report on the relation of small grains to Hessian fly (*Phytophaga destructor* Say) injury, in which it was pointed out that the fly is able to discriminate between wheat, rye, barley and oats in ovipositing, and that there is a marked difference in the infestation of these grains and in the different varieties of wheat. In other words, certain kinds of small grains and certain varieties of wheat were resistant to the Hessian fly. The investigations have been continued whenever sufficient fly has been present and a large

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[1]Contribution from the Department of Entomology, No. 84, and from the Department of Agronomy, No. 142, cooperating. This paper embodies some of the results obtained in the prosecution of projects Nos. 8 and 67 of the Kansas Agricultural Experiment Station. The writers desire to express their appreciation of the assistance rendered by Mr. J. H. Parker, Plant Geneticist, in the selection and propagation of certain of the plants, and to Messrs. H. Yuasa, M. G. Stahl, and F. C. Lewis for carrying out certain phases of the work.

[2]McColloch, J. W., and Salmon, S. C. Relations of Kinds and Varieties of Grain to Hessian Fly Injury. In *Journ. Agri. Research* 12:519-527, 1918.

amount of additional data bearing on resistance has been obtained. While it will not be possible to discuss all these data in this paper, it is the purpose of the writers to present some of the more significant results. Two major lines of investigation have been followed: First, to determine the relative infestation of different varieties and strains of wheat, and second, to determine why certain ones are resistant, or, if not, why they escape injury in some cases where others are seriously affected.

Relative Infestation of Different Varieties of Wheat

The first line of investigation has been conducted to establish the fact that resistance does occur and that it is consistent under various conditions. Numerous plantings have been made in the field each year, and in the greenhouse in 1920-1921. Over two hundred varieties and strains of wheat have been under observation, but, by elimination, this number has been reduced to about thirty in order to facilitate the work. Oviposition and infestation records have been kept on all plantings, and the percentage of infestation in the fall, at harvest, and under greenhouse conditions, is summarized in Table 1, (page 295).

These field and greenhouse tests have established a number of important points. (1) There is practically no discrimination by the adult fly in ovipositing, since eggs are deposited in large numbers on all varieties. (2) There is a great difference in the subsequent infestation, and certain varieties exhibit marked resistance. (3) Since several varieties, such as Illini Chief, Dawson Golden Chaff, Beechwood Hybrid, Currell Selection and Dietz, have had very few plants infested in the fall, they may be classed as resistant. (4) Other varieties as Turkey, Kharkof, Ghirka, Zimmerman, and Marquis, have been very susceptible under all conditions. (5) A few varieties, as Kanred, Clark's Blackhull, and Fulcaster, have been erratic, being apparently resistant in one test and very susceptible in another. (6) The soft wheats, as a class, have been more resistant than the hard wheats, although one variety of soft wheat (Zimmerman) has been decidedly susceptible, while a variety of hard wheat (Red Winter 2132) has shown a marked tendency toward resistance. (7) The infestation at harvest in most cases has been in accord with that in the fall, although in the case of Beechwood Hybrid, Rudy, and Illini Chief, there is a tendency towards susceptibility. (8) Under abnormal conditions, such as greenhouse tests, the plants in general maintain their same relative position with regard to resistance.

The marked resistance of Illini Chief in the earlier experiments led

to an intensive study of this variety. The bulk crop as grown in the field was found to consist of a heterogenous mixture of types and a large series of pure lines were selected and propagated. Tests were conducted in the field at Manhattan and Hays, and in the greenhouse, with 54 of these pure lines, and, with the exception of two strains, all

Table I—Showing the Average Percentage of Plants Infested in the Fall, at Harvest, and Under Greenhouse Conditions

Variety	No.	Kind of wheat	Fall Infestation		Harvest Infestation		Greenhouse 2 tests
			No. tests	Aver. percent infestation	No. tests	Aver. percent infestation	Aver. percent infestation
Marquis..........		Spring	6	19.3			52.3
Kanred..........	2401	Hard Red Winter	9	25.0	4	38.7	40.8
Kharkof..........	382	" " "	8	32.5	3	44.0	33.2
Turkey...........	570	" " "	10	27.8	4	58.7	62.9
Red Winter.......	2101	" " "	9	24.0	3	40.0	57.5
" "	2132	" " "	10	8.2	4	24.7	24.9
Alberta..........	2105	" " "	9	19.4	3	41.3	
Defiance.........	2123	" " "	9	30.6	3	30.7	
Old Crimean......	846	" " "	5	24.0	4	32.0	
Alberta..........	2048	" " "	4	13.0	3	30.7	36.8
Clark Blackhull...	306	" " "	4	17.0	2	10.5	20.6
Beechwood hybrid.	100	Soft Red Winter	10	2.2	4	23.	10.0
Miracle..........	106	" " "	9	4.0	2	6.5	9.3
Currell Prolific....	90	" " "	9	7.1	2	2.5	5.8
Currell Selection...	2406	" " "	10	4.4	4	19.0	
Harvest Queen....	19	" " "	9	4.2	3	12.0	
Valley...........	70	" " "	8	4.2	2	14.0	
Rudy............	77	" " "	10	6.0	4	23.2	0.0
Dietz............	84	" " "	10	2.6	3	6.6	0.0
Illini Chief........	223	" " "	9	1.3	4	17.5	5.5
Zimmerman......	2084	" " "	8	32.2			42.0
Fulcaster.........	83	" " "	7	4.0			31.4
Mich. Bronze.....	2365	Soft White Winter	9	4.0	2	59.5	
Dawson Golden Chaff..........	78	" " "	10	1.8	4	0.0	14.9

showed the same resistance as the bulk crop. Two strains, No. 3278 and No. 3291, had a relatively high infestation at Hays and in the greenhouse, the latter strain being especially susceptible. A study of this strain shows that it differs from all the others, in that the grain is hard and vitreous in texture and resembles a hard winter wheat.

Cause of Resistance

Since the results of the field and greenhouse tests indicated that certain varieties of wheat were more resistant to the Hessian fly than others, the next step to be considered was the cause of resistance. During the past two years, much of the investigational work has been along this line. As there was no apparent discrimination by the adults in ovipositing, it was assumed that resistance was due to morphological or physiological characters of the plant. Preliminary experiments were, therefore, started to determine (1) the ability of the larvae on hatching to get down to their normal feeding place at the base of the plant, and, (2) their ability to rasp the stem and begin feeding. A large series of tests was made with selected varieties of the migration of the larvae and the results are summarized in Table II.

Table II—Showing the Percentage of Larvae that are able to Reach Their Normal Feeding Place on the Different Varieties

Variety	Number	Kind	No. of tests	Total No. larvae	No. of larvae getting down	Per cent of larvae getting down
Marquis		Spring	23	469	377	80.3
Kanred	2401	Hard Red Winter	35	1084	626	57.7
Turkey	2407	" " "	26	564	399	70.7
Red Winter	2101	" " "	43	1148	671	58.4
Red Winter	2132	" " "	31	649	422	65.0
Kharkof	382	" " "	24	383	305	79.6
Turkish Hybrid	196	" " "	27	478	282	59.0
Zimmerman	2084	Soft Red Winter	27	684	404	59.0
Currell Selection	2406	" " "	23	451	339	75.1
Beechwood Hybrid	100	" " "	1	34	11	32.3
Illini Chief	3278	" " "	5	372	159	42.7
" "	3291	" " "	18	714	445	62.3
" "	2591	" " "	54	1714	875	51.0
Illini Chief x Kanred	223x 2401		5	203	104	51.2
Illini Chief Sel. x Kanred Sel	223x 2401		14	1465	443	30.2
Dawson Golden Chaff	78	Soft White Winter	23	611	187	30.6

The results shown in this table may be summarized as follows: (1) There is a high mortality between the time of hatching and that of reaching the base of the plant on all varieties. (2) There is a marked difference in the percentage of larvae getting down on the different wheats, ranging from 30 percent for Dawson Golden Chaff and certain Illini Chief

and Kanred Hybrids to 80 percent for Marquis and Kharkof. (3) There is practically no difference in the ability of the larvae to get down between the soft wheats as a class and the hard wheats. (4) In all cases, enough larvae succeeded in getting down to seriously injure the plant should they develop.

This investigation of the migration of the larvae has failed to demonstrate any marked relation between resistance and morphological characters of the plant, although there is an apparent difference in the ability of the larvae to reach the base of the plant. Careful studies have been made of the structure of the leaf and the ligule, since these are closely associated with larval migration. With the exception of the height of the ligule there has been no correlation between gross morphological characters and resistance. In some of the resistant strains it was found that the ligule was slightly higher than in the susceptible strains, and, therefore, offered a greater barrier.

The next phase to be investigated was the ability of the larvae to develop after they had reached their normal feeding place. Experiments were conducted with a few resistant and susceptible varieties, and, while the number of tests was not as great as in the above experiment, they brought out several significant facts. Only 2.5 percent of the larvae developed on Dawson Golden Chaff; 13.4 percent on Illini Chief No. 2591, a resistant strain; and 62.6 percent on Illini Chief No. 3291, a susceptible strain. On the other hand, from 95 to 100 percent of the larvae developed on Kanred, Red Winter No. 2101 and No. 2132, Kharkof, and Zimmerman. It is of interest to note that Red Winter No. 2132, which has been consistently resistant under field conditions, has not been resistant when grown in cultural media. It was also found that in the case of the resistant varieties, when larval development did take place, it was usually high on the stem and not at the base of the plant. Growth of the larvae was slow on these varieties, and in some cases one-fourth grown larvae were still active and moving about instead of assuming the normal sedentary habit. Undeveloped larvae were generally found at the base where the leaf sheath has its origin.

The results of these observations indicated that resistance was due to physiological conditions and was located at the base of the plant. Experiments were, therefore, outlined for the purpose of studying the various physiological characters of the wheat plant, and especially of the outer cells of the stem. This line of investigation presents many difficulties and necessitates the development of special technique, consequently progress has been rather slow.

The first factor to attract attention was silica, since it occurs in large quantities in the ash of wheat straw. While the silica content of the different varieties of wheat is not known, it has been found in other plants that there is a marked difference, even between strains of the same variety. Silica has also been considered as the basis of resistance in the case of aphids on *Lithospermum arvense*, and of certain plant diseases.

A rather extensive series of experiments has been conducted by growing the different varieties of wheat in Pfeffer's culture solution to which varying amounts of sodium silicate are added. While this phase of the work has been underway for less than a year, and there is still much to do toward developing the technique, certain striking results have been obtained which indicate that silica has an important part in resistance. Several of the very susceptible varieties have shown marked resistance when grown in Pfeffer's solution containing a small amount of sodium silicate and the degree of resistance has varied with the amount of silica. The larvae reach the base of the plant, but as in the case of the resistant varieties discussed above, they do not develop. The data also indicate that different varieties of wheat respond differently to varying amounts of silica. The results have been of such significance that a thorough study of the utilization of silica by the different varieties of wheat is now under way.

Summary

This paper, as the title indicates, is a progress report of the investigations of the resistance of wheat to the Hessian fly. The problem is far from being solved, but the results obtained are encouraging and are presented at this time in the hope that they will be of service to other workers in this field. The results of the experimental work discussed may be summarized as follows: (1) Evidence of resistance has been established in the field and this resistance is fairly constant. (2) The soft wheats as a class are more resistant than the hard wheats. (3) The cause of resistance has not been determined, but many factors have been eliminated. (4) Resistance in young plants is apparently located at the base of the plant. (5) Resistance in wheat cannot be explained by any selective action of the adults in ovipositing. (6) The fact that a sufficient number of larvae get down on all varieties to seriously injure the plant indicates that resistance is not due to gross morphological characters of the plant. (7) The evidence indicates that resistance is due to physiological causes and that silica is in some way associated with it.

FIVE YEARS OF HESSIAN FLY STUDIES IN OHIO

By T. H. Parks, *Ohio State University*

Abstract

Fall plant infestation counts have been made during five years in fields and plats of known dates of sowing. Actual safe sowing dates as they occurred for the same points in northern counties, varied widely during this time. This was apparently due to the difference in intensity of the brood and to meteorological influences. Permanent safe seeding dates are now established, but the entomologists, through surveys, locate the counties where the most intense fall emergence will occur. They, through the county extension service, devote their efforts toward guiding these counties past such an emergency.

Parasitism has been high in all flaxseeds passing the summer months above ground. Submerged flaxseeds gave rise to the most of the fall emergence during these years. Parasitism of submerged flaxseeds is limited largely to *Platygaster hiemalis* Forbes, which deposits its eggs in the fall in the eggs of the host. This parasite has been efficient in killing a high percent of the host larvae developing from eggs deposited during the first wave of emergence of adults, but does not control the host. It is absent in the fields during the visitation of the stragglers of the brood which, in Ohio, is the portion that perpetuates the insect in fields sown near the proper seeding dates.

In the fall of 1919 Ohio experienced the worst outbreak of hessian fly in its history. This outbreak was not unexpected since the entomologists had forecasted it by means of the wheat insect survey. Warnings against early seeding were announced but were not heeded by probably twenty percent of the farmers. Moreover the fly-free dates in northern counties were afterward found to be ten days later than expected. This resulted in widespread damage during the following summer. In 1920 general observation of the seeding dates was carried out by the farmers but the results were complicated by the summer hessian fly puparia dividing into three well defined groups in giving up their adult flies. The majority of the puparia gave up their adults as usual during the latter half of September. Another wave of emergence appeared almost simultaneously over all of the western half of Ohio from October 12th to 18th and during this period of time egg-laying took place on all wheat above ground. A third group, a much smaller one, remained in the summer puparia in the old stubble until the period of normal emergence of the spring brood. This peculiar behavior of the hessian fly in 1920 resulted in practically all wheat in northwestern Ohio becoming infested in October. The larvae grew rapidly throughout November and by December 10th were beginning to change to puparia. This transformation continued throughout December and January though many of the puparia were undersized. These gave up their flies during April and May and at the same time as the puparia resulting from the normal

September emergence and the fraction of the brood that held over in the old summer stubble. Thus in April the three groups arising from the previous summer's flaxseeds had again united. By July 1921 considerable loss from the hessian fly had occurred over all of northwestern Ohio. This was due almost entirely to the "late wave" or abnormal October emergence of 1920. At Columbus, where eggs of the "late wave" flies had been removed during October from several hundred plants, we watched the progress of damage during the fall and winter and compared it with the uninfested plants from which the eggs had been removed. In this way proof was secured that in central Ohio the most of the damage to the 1921 crop was done in the fall rather than in the spring and summer, which was evidently due to the high mortality of eggs deposited during cold weather in April. We also learned that the mid-October emergence had cost the Ohio State University approximately four bushels of wheat per acre on the experimental plats. This damage was much greater in northern counties where the brood of flies was heavier. Southern Ohio counties, by united effort, in 1920 eliminated the hessian fly as a menace in that part of the state. Northwestern counties, which had experienced two years of abnormal late emergence and egg-laying, had not yet completed the job. During the fall of 1921 and again in 1922 a large group of northwestern counties chose Sepember 25th as their first safe seeding date. They were successful in preventing 99% of the wheat acreage being sown before that time. During both of these years the hessian fly emergence had been nearly normal and egg-laying was over in time to make this date safe. Climatic conditions were also favorable for the growth of late sowed wheat. The result has been that northwestern Ohio has at last won their victory and has the hessian fly well under control.

Commencing with the fall of 1920 the Ohio State University and State Experiment Station have each year conducted field emergence stations in two widely separated counties in northwestern Ohio. The manner of conducting these stations has been described in a previous publication.[1] This paper has to do mainly with the follow-up records of the percentages of plant infestation during November and their relation to the time of sowing. We have resorted to the gathering of much local data in these counties as a basis for future recommendations. These percentages of plant infestation were taken from experimental sowing plats and from a large number of fields scattered over these counties. The correct seeding dates of fields were in many cases recorded by the township crops committeeman. The results of the field inspections have been published

[1]Journal of Economic Entomology, Vol. 14, No. 1, 1921.

locally and have been used to good advantage in the fall seeding campaigns. At the present time the few early sowed fields that we can find scattered over these counties furnish the only evidence of what would have happened had the wheat been sown at the time formerly practiced. These fields stand as testimony that the job was well done and that the control that was brought about was due to cooperative effort of the farmers and not by natural agencies.

The hessian fly control in northern Ohio has been difficult because of the following reasons.:

1—Farmers had been used to seeding wheat during the middle of September.

2—The fly-free dates as they occurred varied considerably throughout four of the five years. They were as follows:

1918—Sept 18th in northern counties to Oct 4th at Ohio River
1919—Sept 28th " " " " " 3rd " " "
1920—Oct 10th " " " " " 6th " " "
1921—Sept 22nd " " " " " 4th " " "
1922—Sept 23rd " " " " " 2nd " " "

The record of field infestation as it occurred during the five years in the counties in northwestern Ohio including or adjacent to the site of the two emergence stations is shown in the tables. Where two or more fields of the same seeding date were examined the average infestation for all is given.

Hessian Fly Fall Infestation Determined by Examination of Approximately 100 Plants in Each Field

Erie and Sandusky Counties			Williams County.	
When Sowed	*Percent Infested*		*When Sowed*	*Percent Infested*
Sept 10	24%		Sept 3	12%
11	34%		10	1%
12	34%		17	0%
13	38%		20	0%
14	17%			
15	15%			
18	8%			
20	2%			
21	0%			
22	0%			
25	1%			
28	0%			
		1919		
Sept 22	58%		Sept 6	90-100%
23	63%		12	70-80%
24	47%		17	30-50%
25	38%		18	30-50%
26	41%		20	20-30%
27	6%		22	10-20%
29	1%		24	10%
30	0%		25	0%
		1920		
Sept 15	79%		Sept 15	52%
17	80%		16	41%
23	100%		17	47%
27	35%		18	30%
29	32%		19	36%

Oct 4	43%		20	43%
5	65%		21	22%
7	61%		23	20%
11	7%		25	48%
			28	19%
			29	16%
			30	15%
			Oct 2	12%
			6	0%
		1921		
Sept 15	98%		Sept 8	68%
24	13%		13	79%
26	0%		15	90%
			16	65%
			17	59%
			19	47%
			20	13%
			21	6%
			22	3%
			23	0%
			26	0%
		1922		
Sept 15	76%		Sept 16	29%
16	55%		20	11%
17	42%		21	27%
19	19%		22	2%
20	12%		23	2%
21	16%		25	0%
22	0%			
23	0%			
25	4%			
26	3%			
27	3%			
28	0%			
Oct 2	0%			

The previous narrative of developments throughout each season leads up to the question of whether or not our fly-free date variations as shown above are of sufficient importance to discredit established safe sowing dates for northern counties. We do not believe such to be the case. However, it seems likely that established dates in northern Ohio will be continually subject to modification which should be determined upon by the entomologists. The intensity of hessian fly infestation as determined through the annual wheat insect survey will indicate to us in what particular section of the state and what particular group of counties modifications of established dates should be made. In heavily infested counties it is quite likely that the stragglers of a heavy fall emergence of adults would be equal to or greater than the crest of a light emergence. We have taken care of this by setting the dates two to five days later for such counties than the established dates for the entire state. With the extension organization now furnished within the counties, including committees to decide upon such policies, we find no difficulty in modifying a previously used seeding date when local conditions are explained to these crops committees. Published daily records of hessian fly egg-laying determined at the site of the emergence stations help to impress those farmers previously indifferent to the scheme of cooperation.

Parasitism

Each year since 1918 we have observed parasitism increase rapidly during July and August among all hessian fly puparia located above ground. By September 1st it is usually very difficult to find unparasitized hessian fly in the puparia above ground. It seems that external feeding parasites are able to take care of almost all of these insects which do not become covered with soil after larval maturity in June.

The question is raised as to whether or not external feeding hessian fly parasites, which of necessity must attack the host above ground, will ever become the controlling factor in suppressing an outbreak. Under Ohio conditions the writer has found during September a large percent of the flaxseeds beneath the ground. In Kansas the larger number of flaxseeds are buried in the soil by September. Such observations would lead us to believe that burning stubble even though it could be done, would be harmful rather than beneficial. By this means one would destroy practically all of the flaxseeds which either contain parasites or hessian fly larvae which make possible rapid parasite development.

We have two species of Platygaster which are known to oviposit in the egg of hessian fly and emerge from the puparia. *Platygaster hiemalis* Forbes, the fall emerging species, is the most common in Ohio. These parasites are capable of taking care of hessian fly even though the host becomes subsequently buried and inaccessible to most of the external feeding species. However, our recent studies reveal that *Platygaster hiemalis*, which is known to emerge only in the fall, is present only during the early emergence wave of hessian fly. It was entirely absent from the fields during the mid-October emergence of 1920. At Sandusky, Ohio, in 1921, *Platygaster hiemalis* adults which had been emerging freely during September in the hessian fly cages, ceased emerging September 29th. Hessian fly emergence and egg-laying were quite heavy on September 30th, and continued in reduced numbers until October 17th. Four years analyses of hessian fly puparia show that this parasite is abundant in the puparia infesting early sowed wheat which we discourage but is usually absent or very scarce during the period of visitation of stragglers of the main brood of hessian fly adults appearing late in September. Since it is stragglers of this brood which are liable to perpetuate the species in most seasons, by late sowing we are unconsciously working against these egg-infesting parasites perhaps to even greater extent than their host.

Table of Hessian Fly Parasitism by Platygaster hiemalis Forbes
Miami County Experiment Farm (West Central)

Year	Date Sown	Percent of plants infested with fly	Percent of fly parasitized	Average
1920	Sept 15	90%	85%	85%
1921	15	57%	81%	
1922	15	54%	89%	
1919	Sept 22	100%	57%	61%
1920	22	80%	38%	
1921	22	4%	65%	
1922	22	27%	84%	
1920	Sept 29	37%	6%	6%
1921	Sept 29	0%		
1922	Sept 29	0%		
Hamilton County Experiment Farm (Southwestern)				
1922	Sept 18	68%	67%	
1922	Sept 25	37%	21%	
Bryan, Ohio (Northwestern)				
1921	Sept 15	90%	90%	
1921	Sept 17	59%	46%	
1921	Sept 19	47%	41%	
1921	Sept 21	6%	6%	
1921	Sept 23	0%		

With such an interpretation of parasite behavior, we are lead to believe that hessian fly control is at present largely in the hands of the farmer and his willingness to cooperate. This has been demonstrated to us and we must assume our responsibility in interpreting sufficiently in advance of the need for action that there will be such need and put it in the hands of the farmer. The present farm organizations within the county make the work of the entomologist easier and the responsibility greater.

A NEW APPLE BUD-MOTH IN PENNSYLVANIA

By S. W. Frost, *Pennsylvania State College*

Abstract

A new apple pest (*Sparganothis idaeusalis* Walk.) is brought to the attention of Entomologists. The species has been found abundant during the past five years. Brief life history notes are given showing that it resembles the Eye spotted Bud-moth, very much in habits. Reference is made to related feeders on apple and other fruits.

During the past five summers the writer's attention has been drawn to a new injurious feeder of apple, *Sparganothis idaeusalis* Wlk. It has been known to science for a long time as a general feeder. Fernald (1882) records it as a feeder on Black Haw (*Viburnum prunifolium*) and Blood root (*Sanguinaria* sp.). Mr. August Busck, of the United States National Museum, has unpublished records of the following food-plants: Blackberry (*Rubus* sp.), Osage orange (*Maclura pomifer*) Golden rod

(*Solidago* sp.) and Aspen. The writer has found it feeding abundantly on apple and Blackberry and has referred briefly to this species in earlier papers.[1] Its abundance and preference for apple place it, beyond doubt, among the pests of apple. Having no common name, the writer suggests the Tufted Apple Bud-Moth, taking its name from the conspicuous tufted scales on the fore wings of the adult. This name has been submitted to the committee on nomenclature of the American Association of Economic Entomologists.

This genus contains other species known to attack various fruits. *Sparganothis flavedana* Clem.[2] has been taken by the writer as an occasional feeder on apple, *S. deulticostana* Walsh feeds on cherry while *S. reticulatana* Clem. feeds on pear. There are many other species which feed on forest and shade trees.

Life History

Sparganothis idaeusalis Wlk. resembles the common Bud-moth (*Tmetocera ocellana* Schiff.) in its habits and manner of feeding and it is impossible to distinguish the injuries of the two species. During some years it has been found even more abundant than *Tmetocera ocellana.* Brief life history notes have been taken during the past five summers which give a basis of comparison with the life history of the common Bud-moth.

Eggs

The eggs are apple green in color and laid in patches of a hundred or slightly more. They resemble the eggs of *Tmetocera ocellana* or more closely those of the Red-banded Leaf-roller, *Eulia velutinana* Wlk. but can be readily distinguished from either because of the milky white translucent envelope which surrounds the egg mass, This envelope is much thicker and more prominent than the covering of the egg masses of the species mentioned above.

Larvae

The full grown larva is olive or brownish in color with a chestnut brown head and cervical shield. The cervical shield is uniformly colored, but is often lighter along the anterior margin. Each body segment has four conspicuous silvery setal tubercles which distinguish it from *Tmetocera ocellana* Schiff. A better character, however, is the presence of an anal comb while *Tmetocera ocellana* has none.

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[1]See reference cited to author's papers.

[2]All determinations of species discussed in this paper were made through the courtesy of Mr. August Busck, U. S. National Museum, Wash. D. C.

Adults

The adults are small; seldom more than 12 mm. long. They are inconspicuous in color, varying from gray to brown. The basal one-third of the forewing is lighter in color, usually gray; the outer portion of the wing is darker; usually brown, with a lighter colored area along the costal margin. The tips of the fore-wings are beautifully ribbed longitudinally and beset with two or three groups of tufted scales.

The moths are active and frequently seen flying in the orchards during May, June, August and September.

Seasonal Life History

The half-grown larvae hibernate within the dead leaves of the previous season. The larva usually curls the edge of the leaf, fastening it with an abundance of silken threads. These leaves fall to the ground where the larvae pass the winter. They differ remarkably in this respect from the hibernation of the common bud-moth.

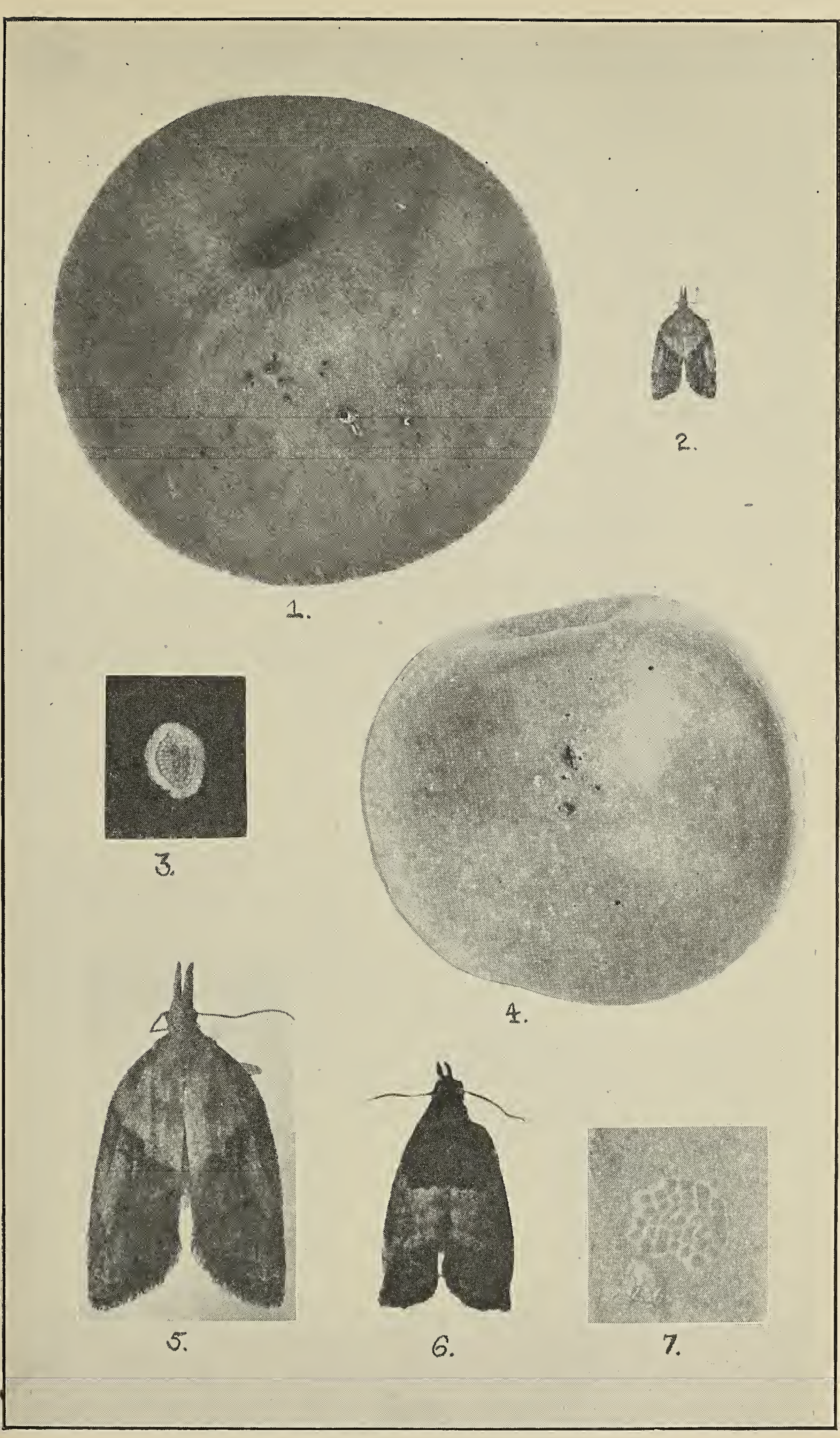
Early in the spring, about the time the buds begin to swell, these larvae leave their hibernating places and seek the opening buds. Here they feed on the developing leaves, often burrowing in the petioles or chewing the blossom.

They become mature towards the end of May or the first of June and transform to brown pupae. Within nine to eleven days the moths issue and a few days later the females lay eggs for a new generation. Some of the larvae hatching from these eggs become mature towards the first of August when they pupate and moths issue, laying eggs for a second generation. The majority of the first generation, as well as all of the second generation enter hibernation as partially grown larvae. It appears that there is normally only one complete generation during a year.

Life history notes taken over a period of five years are summarized in the following table. Intensive work was not begun on this species until 1922 and hence the records for previous years are not complete.

Abundance

This species has been found in numbers sufficient to warrant investigation and is by no means a chance feeder of apple. It has been found not during a single season but has been noticeable over a period of years and may have been abundant even before the writer first discovered it feeding on apple. As an index to its abundance the following counts were taken from a single unsprayed tree. 117 larvae were gathered



1, Bud moth injury on fruit; 2, Adult, *Sparganothis idaeusalis* Walk. natural size; 3, Eggs of *Sparganothis idaeusalis* Walk.; 4, Bud moth injury on fruit; 5, Adult, *Sparganothis idaeusalis* Walk. enlarged; 6, Adult, *Tmetocera ocellana* Schiff.; 7, Eggs of *Eulia velutinana* Walk.

Summary of the Life History for a Period of Five Years

Overwintering larvae			New generation			Partial 2nd Generation
Year	Pupation	Adults emerged.	Eggs laid	Pupation	Adults emerged.	Eggs laid.
1918				Aug. 13	Sept. 14	
1919				July 24–Aug. 12		Aug. 20–Sept. 13
1920	May 31–June 1.	June 8–11			Aug. 24–Sept. 4.	
1921		May 18.			Aug. 1–9.	
1922	May 20–26.	June 1–7	June 7[1]	Aug. 1–7	Aug. 10–28.	Aug. 18–Sept. 5.[2]

[1]56 eggs laid by an individual female.
[2]399 eggs laid by six females.

from the lower branches of the tree; many were missed and some fell to the ground in collecting and were lost. On an examination at the laboratory the following species were discovered; 77 *Sparganothis idaeusalis* Walk., 24 *Eulia velutinana* Walk., 3 *Stenoma algidella* Walk., 1 *Ancylis nubeculana* Clem., 1 *Tmetocera ocellana* Schiff., and one undeterminable larva. It seems very evident, therefore, that this species is worthy of attention by fruit growers.

Literature Cited

Fernald, C. H. Trans. Am. Ent. Soc. Vol. 10, 1882.
Frost, S. W. Bull. 169, Pa. State College.
Jl. Econ. Ent. Vol. 12:447, 1919.
Jl. Econ. Ent. Vol. 14:324, 1921.
Smith, J. B. Insects of New Jersey, 1910.

OBSERVATIONS ON TABANIDAE (HORSEFLIES) IN LOUISIANA

By Thos. H. Jones and W. G. Bradley,
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Abstract

The observations here given in brief supplement the reports of Professor J. S. Hine on the Tabanidae or horseflies of Louisiana. Fourteen additional species have been taken. The larvae of ten species have been collected in the fieldand reared to the adult stage. During 1922 *Tabanus pumilus* was the worst stock pest of all tabanids in the vicinity of Baton Rouge. Two species of dipterous parasites have been reared from tabanid larvae.

During 1905 and 1906 Professor J. S. Hine made a study of the Tabanidae of Louisiana. The results of his work have been published in Circular No. 6 of the Louisiana State Crop Pest Commission (also published as Bulletin No. 5 of the Gulf Biologic Station) and in Bulletin No. 93 of the Louisiana Agricultural Experiment Station. As indicated

in these publications, it was considered advisable that the Tabanidae of Louisiana be studied, not only because of the direct damage they caused to livestock in the State on account of their blood sucking propensities, but also because of the suspicion that they were instrumental in the spread of anthrax or charbon, a dread disease of livestock. In 1920 the Tabanidae, because of their importance, were again made the subject of a project of the Louisiana Station and it is our purpose to here record briefly the progress of this project insofar as the observations made supplement the reports of Professor Hine.

Additional Species Collected in the State

Besides taking the majority of the forty species recorded by Hine as having been found in the State we have collected several others. These include the following, specimens of all of which have been identified by Dr. J. M. Aldrich of the United States National Museum:—*Diachlorus ferrugatus* Say, *Chrysops montanus* O. S., *Tabanus cerastes* O. S., *T. flavius* Macq., *T. giganteus* DeG., *T. lasiophthalmus* Meg., *T. longiusculus* Hine, *T. reinwardtii* Wd., *T. stygius* Say, *T. turbidus* Wd. Additional species, determined by Professor J. S. Hine, are:—*Chrysops separatus* Hine, *Tabanus fuscopunctatus* Macq., *T. imitans* Walker, and *T. aequalis* Hine.

Observations on Adults of Additional Species Collected

Two adult females of *Diachlorus ferrugatus* have been collected. One was taken at Baton Rouge (Apr. 25) and the other at Lutcher (July 2).

Two females of *Chrysops montanus* have been taken in woods at Magnolia (East Baton Rouge Parish) while flying about the collector's head. One was taken between 5:00 and 5:30 A. M. (May 16) and the other later in the day (May 15). A female adult of *Chrysops separatus* was noted feeding at the base of a cow's ear at Baton Rouge on April 7, 1922.

An adult male of *Tabanus lasiophthalmus* was found in a greenhouse at Baton Rouge on March 28, 1922.

A female of *Tabanus stygius* has been taken at New Orleans (Aug. 15) and another has been collected from a mule at Baton Rouge, (May 10). From this same host and in this same locality single females of *Tabanus cerastes* (May 16) and *Tabanus giganteus* (July 28) have also been secured, while females of *Tabanus longiusculus* have been observed feeding on horses near and in woods at Mound (June 29).

Tabanus flavus, a species whose body is of a pale yellowish tinged with green, resembles *Tabanus mexicanus* Macq. in appearance and the

two have been considered synonymous by some workers. Hine has recorded the latter species from Louisiana. Our observations indicate that the adults of *Tabanus flavus*, *T. uniformis*, and *T. turbidus* differ in their habits from the other horseflies that we have taken in that they are crepuscular. Adult females of *Tabanus flavus*, have been observed only during the afternoon of a cloudy day and at dusk. They have been collected from cows and horses; being taken at Magnolia (May 12), Mound (June 29), and Baton Rouge (Aug. 1). At Mound they were common on cows at 7:10 P. M., when ten individuals were counted while feeding on the side of one animal. Adults of *Tabanus aequalis* were common on horses in woods at Mound on June 29, 1922, between 7:10 and 7:55 P. M.

Females of *Tabanus turbidus* have also been observed only on the afternoon of a cloudy day and at dusk, though it is thought that we heard them in flight at about sunrise. Several specimens were taken at Magnolia (May 15) while circling about the collectors between 6:00 and 7:10 P. M. in woods. Although we were in the woods for some time before and after this period no adults were heard in flight at these times. At Mound a single individual was taken on the afternoon of a cloudy day (June 29) about a horse and a number of females were attracted to this animal at the edge of, and in, woods in this same locality between 7:10 and 7:55 P. M. (June 30).

Notes on Immature Stages

It is interesting to note that we have not as yet found larvae of those horseflies that, as adults, we have noted to be the more common species. Our search for larvae has been largely confined to those locations in the neighborhood of Baton Rouge where, as in water and in soil close to water, the majority of the immature stages taken by other workers have been found. This would perhaps indicate that more attention should be given to drier areas in searching for the immature stages.

Numerous larvae of the black horsefly, *Tabanus atratus* Fabr., the immature stages of which are well known, have been taken in wet soil and the larvae of seven other species have been taken from such material and reared to the adult stage in a well ventilated insectary. In all of our rearing work with these species we have kept the larvae in moist sand in small glass jars and fed them on earthworms. This method, while rather tedious, has proven satisfactory. The size of earthworms given as food has been varied with the size of the tabanid larva and it has been found that the amount of feeding that a larva will do depends upon its

size, its stage of development, and upon temperature conditions. Larvae feed but little during cool weather and usually stop feeding several days before pupating. Attempts made to rear larvae in nutrient agar, with the idea that they could be more easily kept under observation in this material, were unsuccessful.

Larvae of *Tabanus trimaculatus* Pal. Beauv. have been taken several times in the field. Some were found in soft mud at the edge of and beneath the water of a pool which is stagnant for the greater part of the year, while others were dug from moist soil beside a brook. Larvae taken in November and December pupated in April and the adults issued in from 8 to 15 days after pupae were formed.

Several larvae of *Tabanus imitans* Walk.have been taken from mud at the edge of a small pool. Taken on November8, 1922, these larvae lived in breeding jars from the first of December until the first of March without feeding and without increasing in size. They then resumed feeding on earthworms and grew rapidly until the first part of April, when they again stopped feeding and became inactive. They remained in this condition until June, when they pupated, and the adults issued 12 or 13 days later.

A single larva of *Tabanus wiedemanni*, O. S., was taken on March 11, 1922, from mud under about ten inches of water in a swampy meadow. It pupated on April 30 and 13 days later the adult appeared. One larva of *Tabanus reinwardtii* and one of *T. fuscopunctatus* have also been collected in the field. The larva of the first named species was found in sand beside a slow flowing brook and that of the second species in the mud at the bottom of a brook. Both pupated in May; the adult of *Tabanus reinwardtii* issuing on May 31 and that of *Tabanus fuscopunctatus* on June 11.

Only two Chrysops larvae have been taken. Both were found early in March in mud under about a foot of water and about two feet from the bank of a small brook. On April 11 the two larvae pupated and after a period of 6 days adults emerged. One was a female of *Chrysops callidus* O. S. and the other a male of *Chrysops flavidus* Wied.

Professor Hine has already recorded observations made in Louisiana which indicated that the immature stages of *Tabanus annulatus* Say occurred in rotten logs. We have taken many larvae and a number of pupae from well rotted logs. With the exception of a single specimen of *Tabanus fulvulus* Wied. no other species has been reared from larvae found in such material. Larvae found in rotten wood were kept in such material in the insectary and fed earthworms. The first pupa of

Tabanus annulatus was formed in confinement on April 11 and the pupal stage of the several individuals under observation average 15 days, adults issuing for the most part during the first few days of May. The larva of *Tabanus fulvulus* was taken late in January, pupated on April 19, and the male adult issued on May 4.

Notes on Adults

We have attempted to ascertain, by field observations, the time of year when the adults of various tabanids occur in the vicinity of Baton Rouge, realizing, however, that this information is not necessarily indicative of conditions in other localities, even in our own State. The following table gives data that we have obtained during 1922 for some of our most common species.

Seasonal Occurrence of Adult Tabanids in the Vicinity of Baton Rouge as Indicated by Collections Made During 1922

Species	Earliest date taken	Latest date taken	Period of greatest abundance
Chrysops callidus O. S.	April 11	June 26	May
" *flavidus* Wied.	April 27	Oct. 4	Summer months
" *obsoletus* Wied.	May 16	Sept. 13	Summer months
" *pikei* Whit.	April 11	June 26	May and June
" *vittatus* Wied.	April 25	Sept. 13	June
Tabanus abdominalis Fabr.	June 26	Oct. 12	September
" *annulatus* Say	May 13	June 29	Never common
" *atratus* Fabr.	April 25	Nov. 1	Never common
" *benedictus* Whit.	June 26	Sept. 20	Never common
" *costalis* Wied.	April 25	Sept. 13	April to September
" *fulvulus* Wied.	May 7	May 16	———
" *fuscicostatus* Hine.	May 16	June 30	May and June
" *lineola* Fabr.	April 25	Sept. 30	Summer months
" *pumilus* Macq.	April 11	July 28	Last week in April and first week in May.

During the spring of 1922 *Tabanus pumilus* was so abundant as to be regarded, as the worst stock pest of all tabanids in the vicinity of Baton Rouge, though it must be borne in mind that in other years or in other sections of the State this species might not rank as so important a pest. The female flies of *Tabanus pumilus* confine their attack, for the most part, to the head of the animal, especially the ears. As a result these parts often become swollen and bloody. In one instance, on a mule, the blood from a large number of bites was flowing down the face and dripping to the ground. The adults do not hesitate to attack man, in which case they also show a preference for the head, especially if a dark hat is worn.

Some writers have already pointed out that certain horseflies are sometimes attracted to moving objects, such as trains and automobiles. We have noted this fact in connection with certain species of Tabanus and Chrysops. Adults of *Tabanus pumilus* and *T. fuscicostatus* have been observed to circle about and alight on an automobile while it was being driven over roads through woods. In one instance adults of the

latter species entered a moving automobile, alighted inside the top, and remaining there, became so abundant as to almost cover it.

Enemies

Two species of dipterous parasites of horseflies have been obtained and determined by Dr. J. M. Aldrich. These are represented by one specimen of *Phasiops flava* Coq. (Family Dexiidae) and two specimens of *Anthrax lateralis* Say (Family. Bombyliidae). Neither species appears to have been heretofore recorded as a parasite of tabanids. The adult of *Phasiops flava* issued from the remains of a larva of what was apparently *Tabanus trimaculatus*. This larva was taken in the field while still alive and the parasite later pupated within the skin of its host.

The adults of *Anthrax lateralis* came indirectly from larvae that belonged, without much doubt, to *Tabanus annulatus*. These two larvae pupated and from each pupa a bombyliid pupa later freed itself, the fly issuing soon afterwards.

A CONTROL FOR JAPANESE BEETLE LARVAE IN GOLF GREENS

By B. R. Leach, *Entomologist, U. S. Department of Agriculture*
and J. W. Thomson, *Investigator, Department of Agriculture, State of New Jersey*

Abstract

The larvae of the Japanese beetle (*Popillia japonica* Newm.) has become a serious pest in golf greens. As many as 300 larvae are found per square yard of turf. Sodium cyanid in solution kills the larvae but completely kills the grass. Emulsified carbon disulfide, when properly applied, controlled the larvae with no injury to the turf, in fact the material is a decided stimulant to the grass, the action being somewhat similar to an application of sodium nitrate.

The larva of the Japanese beetle (*Popillia japonica* Newm.) has become a serious pest in golf greens. The rich soil and heavy turf of the greens attracts the beetles, and eggs are deposited in enormous numbers during June, July and August. Under these circumstances it is not unusual subsequently to find as many as 300 larvae to the square yard of turf. The larvae feed upon the grass roots and by late August or early September the turf begins to turn brown and the green is largely ruined from the standpoint of the game of golf. Unless the green is worked up and reseeded, it is overrun during the following spring by weeds and coarse grasses.

Considerable experimental work was done at the Japanese beetle labortory by J. J. Davis[1] using a solution of sodium cyanide in water as a

[1]Davis, J. J. "Miscellaneous Soil Insecticides Tests" in "Soil Science," Vol. X, No. 1, July 1920, page 61.

control for the larvae in turf. A satisfactory kill was obtained by this method, and according to his published results, the injury to grass was negligible. The writers' subsequent experience with this material corroborates the results secured by Davis as far as grub kill is concerned but in our experience the material is decidedly toxic to the grasses of meadows and golf greens. It kills practically all of the fine grasses and clover in meadows, and completely burns the fine grasses used in golf greens.

In connection with the above experiments the writers carried on tests in 1921 using a plain mixture of carbon disulfide in water, the mixture being maintained by agitation in a tank and run out thru hose on to the turf. The grub kill by this method was not entirely satisfactory, but it was noted that no injury resulted to the grass; in fact the material was *decidedly stimulating in its action.*

Under these circumstances the work with cyanide was dropped and the experiments were confined to a thorough testing of carbon disulfide. It was soon found that a plain mixture of the material in water was unsatisfactory, due to the uneven dispersion of the carbon disulfide thruout the water even when agitated.

The writers therefore began a study of carbon disulfide emulsions, using various solutions of soaps as emulsifying agents. It was found that a fairly stable emulsion could be made with soaps in general, but the best emulsion, from all standpoints was obtained by using resin-fish-oil soap as follows: add 12.5 grams resin-fish-oil soap to 87.5 cc. of water and heat until dissolved; allow solution to cool; place solution in flask or butter churn and add 250 cc. of carbon disulfide: agitate until the ingredients emulsify, this condition being obtained in a few minutes.[2] The emulsion proper is white in color, and the consistency of thick cream. When added to water it diffuses evenly and stays in suspension indefinitely.

Tests were made with this material using various concentrations and various amounts of liquid per square foot of turf treated. For instance, 500 cc. of emulsion was added to a 50 gallon barrel of water[3] and stirred in with a paddle. The solution was then flowed out into the turf by means of a hose and "Ross" watering nozzle, the liquid being applied to

[2]Before making large quantities of this emulsion it is advisable for the novice to experiment with the emulsification of small quantities of the ingredients in an Ehrlenmeyer flask in order to observe the phenomenon.

[3]This concentration is approximately one liquid ounce of carbon disulfide to 4 gallons of water.

an area of 100 square feet, or at the rate of ½ gallon per square foot. The grub mortality was 95% with this concentration.

A lower concentration of solution was not sufficiently effective. On the other hand the grass was not injured by an application of 1,000 cc. per barrel applied at the rate of 1 gallon per square foot. Some injury occurred when 1,500 and 2,000 cc. concentrations were employed. In a few days after treatment with the proper concentration, the grass assumes a vivid green similar to that secured by an application of sodium nitrate.

The liquid is best applied when the turf of the green is fairly dry, since the soil is then in a condition to absorb the liquid with the minimum of run-off. The turf should not be flooded with the liquid. It should be applied lightly and allowed to soak in, and the operation repeated until the stipulated amount of liquid has been applied. Heavy applications applied hurriedly will cause injury to the grass and result in an uneven grub kill due to run-off of the liquid.

In this connection the past season's work has demonstrated the fact that application of the solution to the turf by means of rubber hose, manipulated by workmen, is unsatisfactory, due to unevenness of application with consequent flooding and run-off, and the damage caused by the incessant walking on the wet turf.

Under these circumstances future experimental work will consist in devising a means of automatically applying the liquid to the green. A modified portable overhead irrigation apparatus seems to be the most feasible method.

BORDEAUX MIXTURE AS A CONTROL FOR LEAFHOPPERS

By F. A. Fenton and J. H. Trundy *Entomology Section, Iowa State College*

Abstract

Tests conducted with home-made Bordeaux Mixture, 4–4–50 formula and also with three proprietary preparations of this compound, indicate that these spray materials are toxic to the nymphs of at least one common and injurious cicadellid, namely: *Empoasca mali* Le B. They also are apparently toxic to the nymphs of three other species of leafhoppers, namely: *Empoa rosae* Linn, *Erythroneura comes* Say, and *E. tricincta* Fitch. The young nymphs are more susceptible to the action of the Bordeaux than the older ones, while the adults, although they are repelled from plants sprayed with this preparation, are not affected when forced to feed from treated leaves. Bordeaux mixture should therefore be classed as a specific insecticide for certain species of leafhoppers.

In preliminary tests[1] it was shown that Bordeaux mixture is toxic to the nymphs of *Empoasca mali* Le B. The following account summarizes experiments that not only substantiate the above statement, but also indicate that it is poisonous to the young of three other common species of injurious leafhoppers, namely: *Erythroneura comes* Say, *E. tricincta* Fitch, and *Empoa rosae* Linn.

Three different combinations of self-prepared Bordeaux and three types of proprietary mixtures of this compound were used in these tests. As shown in Table I, the commercial brands acted somewhat more rapidly than the others, all being toxic without exception. The average length of life of the nymphs when feeding from leaves coated with these materials varied from two to three days. In contrast the checks lived for an average period of one week. Over 500 individuals of this species were kept under observation on sprayed potato leaves, and in not a single instance did one mature, unless very near the transformation stage when placed in the vial. Approximately a sixth of them moulted once, and in two cases two moults were observed. The majority died before ecdysis. On the other hand a relatively large proportion were reared to maturity in the vials on unsprayed leaves.

TABLE I. EFFECT OF BORDEAUX SPRAY UPON *Empoasca mali* NYMPHS

Treatment	Number of Days Insects Lived			Number of tests
	Maximum	Minimum	Average	
4-4-50	8	1	3.12	164
4-4-50+Kayso	5	1	3.15	20
8-4-50	4	1	2.95	61
Glidden	6	1	2.39	78
Grasselli	6	1	2.37	67
Sherwin-Williams	7	1	2.08	56
Untreated	17	1	7.24	61

As previously shown,[2] the five instars vary in susceptibility to this spray compound, the first succumbing most rapidly, the fifth being the most resistant (Table II). Adults seem to be comparatively immune to this mixture, for several of them have been kept alive as long as 15 days while feeding on sprayed leaves. The effect at this stage is, chiefly of a deterrent nature.

[1]Fenton, F. A. and Hartzell, A. Journal of Economic Entomology, Vol. 15 pages 295-298, 1922.

[2]Fenton, F. A. and Hartzell, A. loc. cit.

Table II. Effect of Bordeaux Spray Upon Different Instars of *Empoasca mali*

Stage	1	2	3	4	5	6
Average number of days insects lived on sprayed leaves	1.56	1.7	2.06	2.5	2.58	4.55
Control	2	2.16	3.07	3.2	3.39	5.81

The susceptibility of *Empoasca mali* nymphs to Bordeaux spray suggested the possibility of its effectiveness against certain other leafhoppers. Accordingly similar experiments were made with *Empoa rosae*, *Erythroneura comes* and *E. tricincta*, the three species feeding upon apple, and cultivated and wild grapes, respectively. Leaves of these plants were sprayed with this compound and the nymphs confined in vials for observation. Checks were used in all cases. The results are summarized in Table III. Bordeaux was decidedly toxic to these species under cage conditions. When fed on sprayed leaves these nymphs behaved in practically the same manner as those of *Empoasca mali*. The mortality was high, successful ecdysis rare, and none were reared to maturity. It was comparatively easy to rear them through all stages upon untreated leaves.

Table III. Effect of Bordeaux Spray Upon Three Species of Leafhopper Nymphs

Species	Number of days lived on sprayed leaves			Number of tests	Control			No. of controls
	Maximum	Minimum	Average		Maximum	Minimum	Average	
E. comes	10	1	2.8	47	22	1	7.78	23
E. tricincta	7	1	2.53	47	8	1	4.4	10
E. rosae	5	1	2.5	23	9	1	5.5	10

In view of the fact that Bordeaux mixture might possibly be toxic under these conditions and not effective in the field, the following experiment was tried out with *Empoasca mali*. A plot of potatoes was sprayed three times, June 8, July 3 to 5, and July 27. Records were taken of the leafhopper infestations on sprayed and unsprayed plants Table (IV). Weather permitting, daily counts were made of the total nymph population on individual plants selected at random from the treated and check rows. The average daily count for one check plant was 50 while the sprayed vines averaged from 12 to 22. Such a difference as this cannot be explained entirely as the result of a repellant action of Bordeaux upon this species, because frequent rains occurred directly after spraying and washed off a certain amount of the material. Moreover, plenty of unprotected leaves were exposed for oviposition owing to plant growth between spray applications, especially since the

female leafhopper prefers the growing tip for this. These factors tended to offset partly the deterrent action of this material. Therefore, as the insects were left undisturbed after each observation was made, it is believed that these records represent a true insecticidal action of this compound to the nymphs. The apparent discrepancy between the length of life of certain of the plants after the counts were begun, and the relative daily nymph count, was due to the greater size and vigor of these, which was general throughout one side of the field. This was not the result of better protection afforded by any one type of Bordeaux mixture, as check rows located at regular intervals throughout the plot showed this to be due to more favorable conditions for plant growth at this part of the field. These larger plants not only lived longer but supported a somewhat larger leafhopper population.

TABLE IV. SUMMARY OF FIELD COUNTS ON PLANTS SPRAYED WITH BORDEAUX MIXTURES

Treatment	Number of plants	Average No. of nymphs per plant	Average life of plant after infestation	Average daily No. of nymphs per plant
4-4-50	4	848.7	37.25 days	22.7
Glidden	4	493.5	39.5 "	12.49
Grasselli	4	746.75	41.75 "	17.8
Sherwin-Williams	4	894.75	44.5 "	20.0
Control	1	1350	27 "	50

The above tests indicate that Bordeaux mixture is a specific insecticide for at least one and possibly four species of leafhoppers, namely *Empoasca mali*, *Empoa rosae*, *Erythroneura comes* and *E. tricincta*. They appear to substantiate the previous statement by the senior writer that Bordeaux not only protects potato vines from leafhopper attacks by its repellant action on the ovipositing females but that it also protects them because of its toxicity to the nymphs. It should therefore be classed as a specific insecticide for leafhoppers of certain types.

VACUUM FUMIGATION EXPERIMENS WITH BROWN TAIL MOTH AND EUROPEAN CORN BORER LARVAE UNDER WINTER CONDITIONS

By R. I. SMITH, *Boston, Mass.*

ABSTRACT

Fumigation of brown-tail moth, *Euproctis chrysorrhoea* nests, in mid-winter show that brown-tail moth larvae were killed when fumigated at 50° F., and in many cases when the temperatures were as low as 39° F. European corn borer larvae, *Pyrausta nubilalis*, taken from a storeroom at a temperature of 40° to 45° F., and fumigated in a temperature of 65° to 70° F., were not killed. Borers frequently counted as dead from two to fourteen days after fumigation were found to recover

and even complete their transformations. The experiments, with few exceptions, represented two hour fumigation periods, much better results being obtained when the time was extended to from six to ten hours.

On February 8, 1921, Mr. E. R. Sasscer of the Federal Horticultural Board wrote that French fruit seedlings had been arriving at frequent intervals infested with the brown tail moth nests. He said the question had arisen at the Board meeting that day as to whether or not it would be possible to safeguard nursery stock bearing brown tail nests by fumigating at the vacuum fumigation plants with the same dosage of cyanide as employed in the fumigation of cotton. He had been instructed by the Board to ask me to immediately secure brown tail nests and commence a series of experiments to settle the point in question. I made plans immediately and a large supply of nests containing at least 85% living larvae were furnished at my request, by Mr. A. F Burgess of Melrose Highlands.

It should be clearly understood that all the experiments I shall mention today were made in connection with the commercial fumigation of imported cotton as required by the Federal Horticultural Board. The method, as many of you know, is the introduction of hydrocyanic acid gas into the cotton while under a 25″ vacuum. A dosage of six ounces NaCN to 100 cubic feet and a period of two hours is required for all ordinary raw cotton. All of my experiments with brown tail and European corn borer larvae were made with the above charge of cyanide.

My first experiment with brown tail nests was made February 15, 1921. The temperature was 27 degrees Fahr. Fifty nests were fumigated. None of the larvae were killed. Two days later, February 17th, over 150 nests were fumigated at a temperature of 50 degrees Fahr. and all larvae were apparently killed. On February 23d about 100 nests were fumigated at 38 to 39 degrees Fahr. In one nest 173 living larvae and 411 dead were found. In seven other nests the average number of larvae alive was less than 12 each. Sixteen other nests were examined with the result that all the larvae were found dead. On March 1st out of 50 nests fumigated at 45 degrees Fahr. only 2 larvae were found alive in 13 nests examined. On March 7th, 50 nests fumigated at 43 degrees Fahr. resulted in finding 7 larvae alive in three of the ten nests examined. On March 11th, among 50 nests fumigated at 48 to 49 degrees Fahr. we found all larvae dead in ten nests examined. On March 17th, 50 nests were fumigated at 49 degrees Fahr. and all larvae found dead in ten nests examined. On March 22d, 50 nests were fumigated at 42 to 43 degrees Fahr. with the result that all larvae were found dead in five

nests examined. On March 25th, 50 nests were fumigated at 56 to 57 degrees Fahr. and resulted in finding all larvae dead in the nests examined.

In all, 35 experiments were made between February 15th and March 25th, 1921, and without any exception brown tail larvae were killed when fumigated at 50 degrees Fahr. and in many cases when fumigated at temperature as low as 39 degrees Fahr. Even more careful experiments were made in 1922 between the dates of March 6th and May 9th. On the latter date the larvae were crawling in great numbers.

The 1922 experiments confirmed the results obtained in 1921 with one exception. On April 8, 1922, 40 nests fumigated at 51 degrees Fahr. resulted in the finding of 9 larvae alive among 716 which had emerged from the nests prior to fumigation. With this exception the 1922 experiments, 37 in all, proved that the brown tail larvae were always killed at temperatures of 50 degrees Fahr. or above. In many instances they were all killed at 47 degrees Fahr. In one instance they were all killed at 40 degrees and in another at 42 degrees Fahr. In each experiment from 30 to 40 nests were fumigated. In view of all this work I feel absolutely assured that the brown tail larvae in their winter nests may ordinarily be effectively killed if fumigated at a temperature of 50 degrees Fahr. or higher. It should be understood that this fumigation work was all conducted in the large fumigation cylinders used for cotton fumigation.

European Corn Borer Experiments

About one month after commencing the brown tail experiments in 1921, I decided to work with European corn borer larvae under the same conditions. A large supply of borers in corn stalks was furnished by Mr. Caffrey of Arlington. The corn borer experiments were commenced on March 17, 1921 and continued that year until April 25th. The results were very unsatisfactory. Twenty-one experiments were made. The number of borers removed from the infested corn stalks after each experiment, varied from 27 to 142, an average of about 75. Some very contrary results were recorded. The first experiment on March 17th resulted in 74 borers being all apparently killed at a temperature of 49 degrees Fahr. but on March 21st, 52 borers fumigated at 76 degrees Fahr. resulted in only 94% being killed. One month later, April 21st, 72 borers were fumigated at a temperature of 54 degrees Fahr. and only one survived. On April 23d, 71 borers fumigated at 46 degrees Fahr. were all apparently killed and on April 25th, 37 borers fumigated at 50 degrees Fahr. were all apparently killed. Referring again to the record of 52 borers fumigated March 21st at 76 degrees Fahr.,

I know now that that result was not entirely reliable. In other words, the borers themselves having been taken from a cool storage room had not responded in activity to the 76 degrees temperature. Likewise the good results obtained when fumigating at lower temperatures were not always reliable because the borers had sometimes been subjected to warmer weather for two or three days just prior to fumigation and were more easily killed than they would otherwise have been.

Much more exhaustive experiments with the corn borers in 1922 were made, taking advantage of the knowledge already gained the previous year, but the results were equally unsatisfactory. Sixty-five experiments were made from February 6 to June 8. From them it was determined definitely that borers taken from a storeroom at a temperature of 40 to 45 degrees Fahr. and fumigated in an atmosphere of 65 to 70 degrees Fahr. could not all be killed. It was also determined that borers which survived one fumigation at any temperature were often able to survive a second fumigation, some times at a higher temperature, and the records show that one individual borer was fumigated five times before it was finally killed at a temperature of 78 dgrees Fahr. I am forced to conclude that vacuum fumigation with a six ounce charge of cyanide is not effective against corn borers.

In the course of these experiments a surprising condition was discovered. Borers were frequently counted dead for from two to fourteen days after fumigation and then recovered. Many borers that did recover in this manner were placed under incubation conditions and were frequently reared to moths at the Arlington Corn Borer laboratory. It must be concluded that if borers survive the cyanide fumigation they are not weakened to any appreciable extent. It was also found that the large mature-looking borers were no more resistant to the gas than the small immature specimens. It should be explained that all the experiments, with a very few exceptions, represented two-hour fumigation periods. Much better results were obtained in general in the few experiments made when the time of fumigation was from six to ten hours. I feel safe in asserting that a continuous four-hour fumigation is more effective than two separate two-hour fumigations, other conditions being equal.

In view of all my experiments I believe that imported nursery stock may be safeguarded against brown tail moth larvae by fumigation at a suitable temperature, but I do not believe that importation of any

material liable to contain corn borers may be safeguarded by fumigation. It is seldom that material arrives when the temperature is above 75 or 80 degrees Fahr. as would be necessary for certain results against the corn borers.

A STUDY OF THE FACTORS AFFECTING THE OUTDOOR WINTERING OF HONEY BEES

By George E. King, *Department of Entomology, Univ. of Ill.*

Abstract

This investigation was carried on under regular apiary conditions to study the variable factors entering into the outdoor wintering problem.

During a severe winter strong colonies with heavy, medium, and light winter-packing and ample stores suffered a loss in their population in an invesre ratio to the degree of protection given them. Populous colonies slightly protected consumed per unit of population much less stores than weak colonies. Those having a minimum of stores, regardless of packing or population, failed to winter as well as those having ample stores.

Synopsis of Results

This investigation was undertaken for the purpose of studying some of the more obvious principles underlying the successful outdoor wintering of honey bees. It was carried out under regular apiary conditions at the Utah Agricultural College, as an investigation under project No. 50 of the Utah Agr. Experiment Station.

The wintering problem is one of great complexity, the solution of which lies in the determination of the resultant of a number of interacting variables. The most obvious of these variables are such factors as: strength of the colony, age of the bees, quality and age of queens, the quality and quantity of stores for winter, temperature and humidity relations, housing and protection, light relations, etc.

A colony of bees is a complex dynamic unit composed of individuals that are constantly changing. Since the changes taking place in the colony are so varied and rapid, there is little possibility of reducing the technique of investigation to more than a fairly accurate approximation. The aim has been to obtain the desired data by direct and simple methods and through uniformity of procedure rather than by elaborate processes so as to carry the work on under the actual working conditions of the bees.

The twenty-six colonies of bees used in this work were numbered and divided into four groups. The quantity of stores and condition of each colony as regards the number of bees and their relative vigor and age

were determined as accurately as possible. Each group of colonies was packed for winter during late October or early November 1921, in a different manner. One of the methods of packing was possible with but one colony, so that the results in that one case are not conclusive. The other three groups each consisted of from seven to ten colonies.

The methods of packing were representative of three degrees of protection. The least protection given was by means of stacking colonies in single and two-story brood chambers, with entrances reduced to $\frac{3}{8}'' \times 3$ in., facing them south and covering all except the fronts of the hives with tarred paper. A medium protection to a row of two story hives, placed side by side and facing south, was afforded by a layer of 2–3 inches of planer shavings, and a thickness of tarred paper surrounding the stack on all sides, leaving only a $\frac{3}{8}'' \times 3''$ opening at each hive entrance. A thorough protection was afforded a group of eight colonies by packing them in quadruple cases with at least ten inches of planer shavings surrounding them, leaving an outside entrance of $2\frac{1}{2}'' \times 7/16''$.

The winter of 1921–22 in northern Utah proved to be one of the coldest recorded in about thirty years, although sufficient snow fell to partially cover the colonies during the coldest weather.

In order to learn the results of wintering, the activities of all colonies were carefully observed during late winter when the bees were likely to fly out and their condition and strength checked as promptly as was possible at the beginning of spring. While drifting was an almost negligible factor, the averaging of results has been made in such a manner as to avoid error from that source.

The results show that a relatively greater quantity of stores are consumed by a unit population of bees in weak colonies even though they are well protected, than is necessary for the same number of bees in a strong colony even with much less protection. Colonies with a minimum of stores failed to winter as well, or as economically as those well supplied with stores, regardless of the population of the colony or the thoroughness of the packing. The idea expressed by many beekeepers, that the sunshine warms up and benefits colonies left with their fronts uncovered was not borne out by these observations. The bees ventured out less on bright cool days from colonies housed in double brood chambers with small low entrances than from those in which light could enter more freely. This resulted in the loss of fewer bees from flights in cool weather, from the protected colonies and much more rapid spring breeding.

Strong colonies wintered in double brood chambers with ample stores and reasonable protection, set with their entrances near the ground

showed a total average loss of but 2.1+% of their bee population, whereas the loss from equally populous colonies in hives having their fronts exposed was about 4%. The loss in the population of colonies wintered in single hive bodies ranged much higher.

The disposal of moisture from the colonies may be effected almost entirely through the entrance, provided the bees are warmly packed. The only moldy combs found were in hives in which the frames hung to within 3/8 inch of the bottom board, affording a condition in which dead bees and refuse piled up against the combs. Colonies having ample stores and protection not only wintered better but began heavy breeding much more promptly at the opening of spring than those not so supplied.

While the amount of data from this work is insufficient to permit the drawing of final conclusions, it nevertheless points out rather definitely some of the reasons for the loss of the bee population during winter and the requirements to prevent that loss. Further experiments should be undertaken and carefully prosecuted on a more intensive and extensive scale, so that as many as possible of these interacting variables might be considered simultaneously and the results treated as a unit rather than as isolated phases of the same great problem.

FUMIGATION OF WASHINGTON BARRACKS AND ARMY WAR COLLEGE BY THE CHEMICAL WARFARE SERVICE

By Harry A. Kuhn, *1st Lieut., C. W. S., U. S. A.*

The Chemical Warfare Service, by the research and investigation incidental to its fundamental role of providing our nation protection against the possible use against our armed forces or our civilian population of chemical warfare agents by an unscrupulous enemy, is producing by-products of great value to art, science and industry.

In co-operation with government departments and scientific, industrial and educational organizations, it is making a distinct contribution to the beneficent use of scientific knowledge.

The following report covers an incident in the work of developing a safe and more efficient method of ship fumigation.

The cyanide compounds, owing to their ability to produce rapid incapacitation and rapid death, were investigated quite extensively by the research organizations of the Chemical Warfare Service during the past World War. Hydrocyanic acid, cyanogen chloride, cyanogen bromide, cyanogen sulphide, methylcyanoformate, powdered sodium cyanide and various other organic and inorganic compounds containing

the cyanide radical were discarded for various reasons, the principal reason being the inability to build up and maintain a sufficiently high concentration in the field owing to their low density. When the Public Health Service in 1922 requested the assistance of the Chemical Warfare Service in finding either a compound which could be released with hydrocyanic acid to make the presence of hydrocyanic acid more noticeable or to develop a substitute for hydrocyanic acid in ship fumigation this data on cyanide compounds was made available to them.

After some little experimental work it was found that although a lachrymator could be very readily released with hydrocyanic acid the lachrymator persisted after the cyanide had been cleared out of the ship's hold. Work was then begun on a substitute for hydrocyanic acid. This substitute was to be as toxic to rodents and vermin as hydrocyanic acid; must either have a powerful odor or be a lachrymator so that its presence could be easily detected. It must also be readily generated in place in similar fashion to that used for generating hydrocyanic acid, i.e. by dropping a relatively inert cyanide compound into an acid where a more active cyanide gas was formed. The compound must also be very volatile and as readily cleared out of the ship's hold as hydrocyanic acid. After considerable experimentation in conjunction with the Public Health Service cyanogen chloride, generated by dropping the desired amount of granulated sodium cyanide and sodium chlorate into dilute hydrochloric acid, was selected as possessing all the qualifications of hydrocyanic acid. Cyanogen chloride is almost as toxic to insects and vermin as is hydrocyanic acid and in addition is a vigorous lachrymator. It was found to be a very good germicide which is not true for hydrocyanic acid. Cyanogen chloride, generated in this manner, was tried out and proved effective in ridding various buildings at Edgewood Arsenal of rats, mice, bats, roaches and bedbugs. In addition work has been carried out by the Public Health Service against other sorts of vermin and germs, both in the laboratories and on board ship. This gas will soon be used by the Public Health Service on all ship fumigation carried on under that bureau.

The Quartermaster of Washington Barracks requested the Chief of Chemical Warfare Service to try cyanogen to rid various buildings at Washington Barracks and the Army War College of roaches and ants which had increased to such a number, despite insect powders of all sorts, that they had reached the proportions of a plague. This report covers the fumigation of these buildings at Washington Barracks and the Army War College. The buildings included the Post Quartermaster's

office, which was infested with roaches and ants; the Barracks mess hall kitchen and store rooms infested with roaches; the Army Music School mess hall, kitchen and store room which were infested with roaches and bedbugs; non-commissioned officers' quarters infested with bedbugs; and an officer's residence infested with red ants; the record rooms, executive offices and the commanding general's office of the Army War College which were infested with ants and roaches. The cubic contents of the buildings gassed ranged from 20,000 to 200,000 cubic feet. The maximum concentration used was six ounces of sodium cyanide mixed with three ounces of sodium chlorate per 1,000 cubic feet. This concentration was used in the Quartermaster's office, mess halls and the non-commissioned officers' quarters. For the officers' residence and the Army War College the sodium chlorate was reduced to one and one-half ounces with six ounces sodium cyanide per 1,000 cubic feet.

The gas was generated by dropping bags made of two thicknesses of cheese cloth containing six ounces of sodium cyanide, crushed to about the size of a bean, mixed with the required amount of granulated sodium chlorate into a three gallon crock containing 1,500 cubic centimeters commercial hydrochloric acid which had been diluted with 1,500 cubic centimeters cold water. With a three gallon crock such as we used, double charges sufficient for 2,000 cubic feet, i.e. twelve ounces of sodium cyanide, six ounces sodium chlorate, three liters of commercial hydrochloric acid and three liters of water, can be used. The gases are a mixture of cyanogen chloride and hydrocyanic acid, generated according to the following formulae:

$$3\ NaCn + NaClO_3 + 6\ HCl = 4\ NaCl + CnCl + 3\ H_2O$$

$$Na\ Cn + HCl = NaCl + HCn$$

The usual time of exposure was two hours, with the exception of the non-commissioned officers' quarters where the time of exposure was three hours. It was found that bedbugs required longer time of exposure to kill than do roaches. The buildings were aired out by opening the windows and in every case they cleared out so that it was not necessary to use a gas mask within one-half hour. The casualties on roaches, ants, bedbugs, rats and mice were practically one hundred per cent. There was no evidence of corrosion of any sort of metal or any injury to any sort of fabric in any of the dwellings or buildings gassed. In the dwellings there were pianos, victrolas, brass beds, silver ware, bronze statuary and clothing of all sorts which were uninjured. In one of the mess halls there was a large rubber plant and two aspedistra plants all of which were placed close around one of the generators and after the gassing

showed no injurious effects. It was not possible to try the effect of cyanogen chloride on young growing plants. There was very little evidence of the formation of either free chlorine or chlorine dioxide with a mixture of four parts of sodium cyanide to one of sodium chlorate and it is thought that this ratio could be very safely used even against young growing plants.

Scientific Notes

Do Rats Eat Mealybugs? Several observers have noted that where mealybugs (*Pseudococcus spp.*) occur on sugar cane in some tropical countries stalks will be found with the leaf sheath gnawed through in one or two places and the mealybugs which were on the stalk underneath no longer there. An entomological friend, though he had not seen any animal doing this work, assumed that it had been done by rats, which he thought gnawed through the leaf sheath to feed on the mealybugs. A bulletin has now been issued by another worker in another country giving credit to rats for this aid in control, but again the rats have not been seen in the act.

As far as I know rats may feed on mealybugs, but at Mercedes, Cuba, on September 12th, 1918, I noticed the large reddish ants common in Cuba carrying mealybugs away in their mandibles through holes in the leaf sheaths which they had undoubtedly gnawed. Specimens of the ant were afterwards determined by Dr. W. M. Mann as *Atta insularis* Guer. I have the specimens before me with the note which I made at the time.

While the matter is perhaps of little economic importance, it might be just as well not to credit rats with a partial control of the sugar cane mealy bugs until more definite observations have been made. It might be mentioned that though mealybugs occur on sugar cane in Louisiana this gnawing of the leaf sheath has never been observed. Rats are present, but large species of ants are not.

T. E. Holloway, *U. S. Bureau of Entomology*

Colorado Potato Beetle in France. The readers of the Journal may be interested in the recent outbreak of the Colorado potato beetle in France, reported in a special number of the *Revue de Zoologie Agricole*, published in August 1922. The paper is entitled, "Le Doryphore. Chrysomele nuisible a la pomme de terre (*Leptinotarsa decemlineata* Say)," by Jean Fcytaud. This beetle was discovered on June 9, 1922, at Taillan in the Department of Gironde and was later found rather widely scattered throughout the department in the general vicinity of Bordeaux. It is believed to have been introduced accidentally in importations from America in 1919 or 1920.

An interesting feature is the fact that within five weeks after discovery an emergency appropriation of five hundred thousand francs had been made available for control measures and that the former law, which refused indemnity to the owners of fields destroyed, had been amended in this respect. Within the same period extensive machinery has been organized for control measures, including departmental committees of defense.

Dr. Feytaud's paper not only discusses this outbreak and the plans for eradication or control but includes a most interesting and exhaustive outline of the various discoveries of the Colorado potato beetle in Europe from the time this species reached the Atlantic coast in the United States in April, 1875, to the present. These outbreaks which were more numerous than seems to be generally understood in this country, have all resulted in complete extermination up to the present time with the possible exception of one at Hohenwedel, Germany, in 1914, about which there seems to be inadequate information.

The activities in France, in connection with this new outbreak and the successful campaigns of the past are particularly interesting, in view of the several entomological eoradication projects under way in the United States at the present time.

S. B. FRACKER, *Madison, Wisconsin*

Note on a Bombyliid Parasite of the Pale Western Cutworm (*Porosagrotis orthogonia* Morr.) During several past seasons extensive rearings have been made of *P. orthogonia* from collections of larvae made in various parts of Montana, and a considerable amount of data accumulated upon the occurrence and abundance of parasites. Until 1922 only two Dipterous parasites, *Bonnetia compta* Fall. and *Pleteria robusta* Wied., have been reared from this species. Both of these are Tachinidae.

In 1922 we found among our Noctuid pupae which were supposedly ready for emergence several actively moving pupae of a Bombyliid fly. These moved actively about for a few hours, then became quiescent upon the soil surface, and the flies emerged about two days later. The fly has been determined for us by Mr. J. M. Aldrich of the U. S. National Museum as *Anthrax* sp. and fifteen were reared from 116 larvae caged, or about 13%.

A search of the economic literature brings to light the parasite recorded by Allen from the Southern Grass Worm (*Laphygma frugiperda* S. & A.) (Journal Ec. Ent. 14; 510, 1921) as the only recent record of a Bombyliid as an economic factor in cutworm control. The fly (*Anthrax lucifer*), reared by Allen, has a life history precisely similar to our species of *Anthrax*, so far as observed.

This fly is apparently confined to *P. orthogonia*, as extensive rearings of several other common species of Noctuids, including *Euxoa pallipennis*, *E. dargo*, and *Porosagrotis vetusta*, failed to disclose a single specimen of *Anthrax*.

WILLIAM C. COOK, *Montana Agricultural Experiment Station*

Calcium Cyanide Dust as an Insecticide. In August and September, 1922, 25 or 30 orange and lemon trees were fumigated by blowing finely powdered calcium cyanide under tented trees to determine the effect of such material on citrus trees and on the scale insects infesting them. The trees were infested with the black, red and citricola scales and a complete kill of these scales was effected without any injury to the trees. Other trees were fumigated in the same way later in the season when rains and moist weather followed with the result that, while the scales were killed, some injury to the trees was apparent. The injury, however, appeared to be only temporary. During a dry period in January, one or two other trees were fumigated without injury. Moisture seems to be an important factor in connection with the possible use of powdered calcium cyanide as a tree fumigant, and further work to determine its effect is now in progress.

Powdered calcium cyanide has also been used as a soil fumigant, and results thus

far indicate that this form of cyanide is well adapted for soil fumigation. Hydrocyanic acid gas is readily given off and the powder is easily applied in the soil. It would be possible to apply it in the soil on a large scale by means of a drill. Woolly aphis and other soil infesting insects have been killed with the use of 2 oz. per sq. yd. Little has been determined thus far as to the effect of the powder on the roots of trees but the indications are that it is less injurious than a solution of any form of cyanide.

A few preliminary experiments have also been made with the peach root-borer. Where the material was applied directly to the tree a good kill of the borers resulted, but the effects on the tree remain to be determined. It is also planned to make tests against nematodes where these occur with normal crops. It has already been used with considerable success against ground squirrels. The University of California Citrus Experiment Station is engaged in an investigation of the uses of powdered calcium cyanide as an insecticide and, at the present time, the work has proceeded far enough to indicate merely some of the possibilities rather than to make any definite claims supported by sufficient data.

H. J. Quayle, *Citrus Experiment Station, Riverside, Calif.*

Calcium Cyanide for Chinch Bug Control. Experiments with Calcium Cyanide for control of the chinch bug were started at Illinois, in June 1922. The material was used at first in flake form, as this was the only form procurable, at that time. It was scattered along the margins of stubble fields, from which chinch bugs were migrating to the corn, and used along barriers where the bugs were stopped in their migration from the small grain fields. When scattered over the ground, in a strip, three inches wide, and sufficiently thick, so the flakes were not more than an eighth of an inch apart, it was found that this material would kill every bug crossing it, for one hour to three hours, depending on the temperature, the amount of moisture in the soil and the humidity. The flake material was scattered around the base of hills of corn, and behind the sheathes of lower corn leaves, heavily infested with chinch bugs. Practically 100% of the bugs on the corn hills treated in this way, were killed, where they were feeding within three inches of the Cyanide flakes.

During the latter part of the summer, a dust cyanide was secured, and was tried at strengths of 3, 6, 9 and 12% in a ground spent tobacco dust carrrier. The 3 and 6% strengths, gave only a fair degree of kill, when dusted on chinch bugs in grass or behind leaves of corn stalks. The 9 and 12% strengths gave a much better kill, the 12% killing about 95 to 98% of the bugs, within three inches of the point of application.

During the past winter, this material has been tested, on hibernating chinch bugs, placed in wheat and on the bare earth in a greenhouse. The results obtained from these experiments have confirmed the work of the previous summer. Extensive field experiments, to test the effect of this material combined with different carriers, and at different strengths, will be carried out in Illinois and neighboring states, during the coming season. If the material proves as effective as indicated by the experiments of last year, it will be possible to use it for field applications, against the chinch bug. The cost of such application would not be so high, that it would be impractical for a farmer to use it.

W. P. Flint, *State Entomologist, Natural History Survey, Urbana, Illinois*

Preliminary Announcement of Meeting, Pacific Slope Branch, American Association of Economic Entomologists

The next regular meeting of the Pacific Slope Branch of the American Association of Economic Entomologists will be held in connection with the Pacific Division A. A. A. S. at the University of Southern California, Los Angeles, Cal., September 17, 18, 19, 1923. A partial program has been suggested as follows: Tuesday, Sept. 18—At University So. California, Los Angeles, Cal. Forenoon—Business Meeting. Afternoon—Symposium on Dusting, R. E. Campbell, leader. Evening—Round Table Discussions, G. P. Weldon, leader. Wednesday, Sept. 19—Branch State Insectary, Whittier, California. All day symposium on Biological Control of Insects, H. S. Smith, leader. Evening—Dinner and Speeches. We shall be glad to have you submit topics of papers on any general subject of Economic Entomology which you may choose. Because of the lack of space and cost of printing, may we request that each member submit only one paper for publication in the proceedings, but may present as many at the meeting as desired. There is so much entomological work in progress in Southern California that we are looking forward to a large attendance at the meeting this year and trust that you can arrange your work to be present.

E. O. Essig, *Secretary*
E. R. Capmbell, *Acting Chairman*

Summer Meeting

The entomologists of the northeastern United States will hold their summer meeting this year in Connecticut the latter part of July, probably July 26 and 27. Entomologists should bear this in mind and be ready to engage accommodations as soon as definite arrangements can be announced. Further information will be sent by mail to members.

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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The air as a medium of dispersion deserves more than a passing thought. Insects are well known inhabitants of the air and it has long been known that apterous spiders make long voyages with no more stable support than a gossamer web. Later investigations have shown that small caterpillars may literally drift upon the "wings of the wind" and in the case of young caterpillars of the gipsy moth this is known to be a most important method of spread. It is evident that the lower wind currents are very important aids to the spread of insects and yet relatively little is known concerning them. The part winds play in the spread of insects has a very material bearing upon the proposed barrier zone which may be established in New York State to prevent the westward trend of the gipsy moth. A series of temporary weather stations have been established in western Massachusetts and Connecticut and a few in adjacent portions of eastern New York for the purpose of securing data on the direction and velocity of the winds at the time young gipsy moth caterpillars are likely to be carried and in addition toy balloons are being liberated on definite schedules from a series of stations for the purpose of supplementing the data obtained from the weather stations. This extension of earlier work of federal men and in co-operation with them bids fair to yield some most interesting results.

Current Notes

The nursery inspection work in North Dakota is now in charge of Professor R. L. Webster.

The office of the State Entomologist of Illinois has been merged into the Illinois State Natural History Survey.

The North Dakota legislature recently passed a foulbrood law and Professor R. L. Webster has been appointed state inspector for apiaries.

Mr. George Knowlton, a graduate student, is acting field man in Entomology at the Agricultural Experiment Station, Logan, Utah.

Professor George A. Dean, of the Kansas Agricultural College, Manhattan, visited Washington April 24 to attend the meeting of the National Research Council.

Dr. W. D. Hunter of the Bureau of Entomology addressed the annual meeting of the Texas Cotton Association at Dallas, Tex., on March 24.

The following resignations from the Bureau of Entomology have been announced: Dr. H. L. Dozier, Dr. William Moore, H. L. McIntyre, J. C. Bridwell, and H. P. Wood.

At the North Dakota Agricultural College the department of entomology is being provided with increased quarters in the new agricultural building recently completed.

Professor J. S. Houser of the Ohio Station attended a grape growers' conference at North East, Pa., on March 6, and conferred with entomologists concerning spraying programs.

According to *Science*, Dr. G. A. K. Marshall, Director of the Imperial Bureau of Entomology, London, England, has been recommended for election to membership in the Royal Society.

Professor S. B. Freeborn, Assistant Professor of Entomology in the College of Agriculture, University of California, has been granted a sabbatical leave of absence for study and travel.

Dr. I. M. Hawley, head of the Department of Zoology and Entomology at the Utah Agricultural College, has been made Acting Dean of the College of Arts and Sciences, for the coming year. Dean Saxer will be away because of poor health.

H. J. Pack, Assistant Professor of Zoology and Entomology of the Utah Agricultural College, will be away on leave to do graduate work at Cornell University. His substitute has not been definitely appointed at this time.

Mr. Don Gill is instructor in apiculture at the Utah Agricultural College. The college has an apiary of thirty-two colonies. The courses given are primarily for disabled soldiers, and at times forty men have been registered in this work.

Dr. William Moore of the Japanese beetle laboratory, Riverton, N. J., resigned in February to accept a research position with the American Cyanamid Company in New York, N. Y.

Professor H. B. Hungerford of the University of Kansas, will be one of the teachers at the University of Michigan Biological Station, Douglas Lake, Mich., July 2 to August 24.

The United States National Museum has recently received, as an exchange from the British Museum, about 300 species of Old World Orthoptera, most of which are new to the collection.

Transfers in the Bureau of Entomology have been announced as follows: A. C. Mason, Orlando, Fla., to Lindsay, Calif.; A. J. Flebut, Fresno to Lindsay, Calif.; E. R. Van Leeuwen, Medford, Ore., to Riverton, N. J.

Mr. Samuel T. Sealy, deputy in charge of mosquito control work in Connecticut, resigned April 1, and the work has been assigned temporarily to Mr. B. H. Walden, Assistant Entomologist of the Connecticut Station.

Dr. E. A. Back of the Bureau of Entomology gave an address on insects attacking upholstered furniture before the National Association of Upholstered Furniture Manufacturers, on April 11, at the Hotel Traymore, Atlantic City, N. J.

Mr. G. F. Moznette of the Bureau of Entomology with headquarters at Miami, Fla., attended a meeting of the State Horticltural Society at Orlando, April 16, and gave advice on tropical and subtropical fruit insects.

Mr. Harold E. Woodworth, formerly professor of entomology at the University of the Philippines, Los Banos, has resigned his position and is at present connected with the California Spray Chemical Company with headquarters at Watsonville.

Dr. J. M. Swaine has been appointed Associate Dominion Entomologist in place of Chief, Division of Forest Insects, and will assist the Dominion Entomologist in the general work of the Branch, particularly that pertaining to research.

Mr. C. M. Smith of the Bureau of Entomology read a paper entitled "Excretion from Leaves as a Factor in Arsenical Injuries to Plants," at the meeting of the American Chemical Society, New Haven, Conn., April 2-7.

According to *Science*, Dr. Vernon Kellogg gave a series of three lectures on March 13, 14 and 16 at Princeton University on "Kinds of Minds." These lectures will be published in book form by the Princeton University Press.

According to *Science*, Professor A. C. Burrill has resigned as extension entomologist of the University of Missouri, to accept a position as curator with the Missouri Resources Museum Commission in the new State Capitol Building, Jefferson City, Mo.

The Thomasville, Ga., substation of the Bureau of Entomology has been discontinued on account of the light infestation of the bean beetle during the past season, and the fact that available funds no longer permit the maintenance of this station.

The following appointments to the Bureau of Entomolgy have been announced: H. S. Adair, Fort Valley, Ga.; C. K. Fisher, Junior entomologist, Alhambra, Calif.; Wm. D. Mecum, Madison, Wis.; temporarily for Japanese beetle quarantine service, F. H. Wersinger Jr., G. B. Stichter, C. H. Buckman; insecticide investigations, L. L. Golden.

Dr. John N. Summers of the Bureau of Entomology gipsy moth parasite laboratory at Melrose Highlands, Mass., who visited Japan last year to secure parsites of the gipsy moth, has gone to that country again and will continue his studies of the gipsy moth and its parasites.

On the evening of April 19th, W. R. Walton gave a lecture before the Manitoba Natural History Society at the University of Manitoba on the subject of "Some

Phases of Insect Parasitism," a purely popular treatment of the subject which will be published in the *Canadian Field Naturalist.*

According to *Science,* Professor and Mrs. T. D. A. Cockerell of the University of Colorado will sail on June 4 from San Francisco for Yokohama. Thence they will proceed to Vladivostock, in order to investigate a deposit of fossil insects recently discovered on the coast of Siberia, returning to America in September.

According to *Science,* Professor D. L. Van Dine, extension entomologist of the Pennsylvania State College, has been appointed one of the scientific trustees of the Tropical Plant Research Corporation, a newly formed organization, the objects of which are to promote research for the advancement of knowledge of the plants and crops of the tropics.

Mr. W. E. Haley of the Bureau of Entomology has started experiments in southern Louisiana with the new hot water treatment of sugar cane. It has been found that soaking the cane in water heated to a certain degree destroys borers in the cane and at the same time hastens the germination of the stalks when planted.

Dr. A. C. Baker will assist Dr. Quaintance in administrative work in the office of Fruit Insect Investigations, Bureau of Entomology. He will continue as custodian of the aphid and aleurodid collections, and will have time to pursue his studies in these families. A. C. Mason, under Dr. Baker's supervision, will devote all his time to the aphididae.

The results of the work of the Bureau of Entomology on insects affecting dairy cattle will be shown at the National Dairy Exhibit to be held at Syracuse, N. Y., next October. Practically every bureau in the department will have some part in the exhibit. It is expected that one booth will be devoted to entomological problems.

Dr. L. O. Howard, who is now abroad, has been made honorary president of the International Conference of Phytopathologists and Economic Entomologists, which is to be held at Wageningen, Holland, on June 24. Dr. Howard will also attend the International Congress of Agriculture at Paris May 22–26, and the international conference concerning *Dacus oleae,* to he beld at Madrid on June 18.

Dr. C. W. Woodworth, director and chief entomologist of Kiangsu Province, China, spent Thursday, April 19, in the section of insects, U. S. National Museum, consulting some of the specialists in regard to specimens he collected. Dr. Woodworth's headquarters are at Nanking and he has associated with him the following Chinese entomologists as well as other workers: Goey Park Jung, C. Francis Wu, and Hai-san Chang.

The position of Assistant Professor of Beekeeping at the Massachusetts Agricultural College made vacant last fall by the resignation of Professor N. E. Phillips, has been filled by the appointment of Mr. Morton H. Cassidy, a graduate of the College who received his training in Beekeeping under Dr. B. N. Gates, and who has since that time been actively concerned himself, in Beekeeping. Prof. Cassidy began his work April 1.

According to the *Florists Exchange,* the Colorado potato beetle has made its appearance in France where nearly 100 square miles in the Bordeaux district are infested. Presumably it was carried from the United States to France in some kinds of produce, not necessarily potatoes. The British Government warns potato growers to watch for the pest and has prohibited the importation of plants and bulbs from the infested region in France.

At the spring meeting of the American Chemical Society in New Haven, the section of insecticides and fungicides on April 5 listened to papers by the following entomologists: Dr. E. D. Ball, Prof. W. C. O'Kane, A. E. Kelsall and Dr. William Moore. Mr. G. E. Sanders was on the program for two papers but was not present. Papers by P. J. Parrott and Hugh Glasgow and by P. J. Parrott and L. R. Streeter were read by Mr. Streeter.

Mr. E. Graywood Smyth, investigating the Mexican bean beetle for the Bureau of Entomology, sailed early in April for Puerto Barrios, Guatemala. From this point he will proceed to the interior in an endeavor to obtain additional parasites of the Mexican bean beetle suitable for introduction into the eastern United States. The territory in eastern Guatemala, high and subtropical in character, should furnish parasites capable of living in the southeastern United States.

Mr. A. J. Ackerman, Bureau of Entomology, in charge of apple insect investigations at Bentonville, Ark., and Prof. Geo. A. Dean, of the Kansas Agricultural College, met with fruit growers of the Arkansas Valley at Wichita, Kans., recently to discuss methods of aiding growers in the Wichita section in their fight against the codling moth during the coming season. Plans were made for co-operative work in the orchards at Wichita and at Belle Plain, Kans.

Mr. C. T. Dodds, candidate for a Ph.D., University of California, has recently been appointed to take charge of the parasitic control work of the Santa Paula Citrus Association representing some 10,000 acres of citrus trees in Ventura County, California. His work has to do chiefly with the control of the black scale by means of parasitic and predaceous insects which will be reared in a newly constructed and modern insectary. Mr. Dodds is abundantly qualified to take over this very important work.

According to *Science*, Professor F. L. Washburn of the University of Minnesota has returned from the South Pacific with a collection of several thousand specimens of insects for that institution from the Marquesas and Society Islands. Almost all orders are represented and sufficient material in the various families was secured to afford opportunity for exchange with other institutions. Most of this material was secured at from 200 to 300 feet above sea level, but many specimens were also taken at elevations of 1,500, 2,500 and 2,800 feet.

Mr. Samuel S. Crossman and Ray T. Webber of the Bureau of Entomology gipsy moth laboratory, Melrose Highlands, Mass., will visit Europe during the spring and summer of this year to secure beneficial species of parasites to aid in the fight against the gipsy and brown-tail moths. Mr. Crossman spent several months in Europe last year, and as a result of his observations it is believed important to continue the work of importing, breeding and colonizing of European parasites of the two insects. Material as collected will be shipped to the laboratory at Melrose Highlands, Mass.

Mr. H. G. Crawford of the Entomological Branch, Canadian Department of Agriculture, returned from a trip to southern Ontario on April 4 where he arranged for the beginning of the season's work. Considerable quantities of corn stalks were found to have been carried into Lake Erie by water from the spring floods. Material was also found frozen in the dislodged ice. This ice was later blown out into the lake by the winds from the north, suggesting a probable means of infesting the southern shore of Lake Erie.

Mr. T. E. Holloway has just returned from a six week's trip to the west coast of Mexico, including Lower California. Dr. W. M. Mann of the Bureau of Entomology, H. C. Millender of the Federal Horticultural Board, and M. Alcazar, delegated by the Mexican entomological service, made the trip at the same time and are now in Southern Mexico. A visit was made to Los Mochis, where R. H. Van Zwaluwenburg, entomologist of the United Sugar Companies and a former employee of the Bureau, is testing various control measures against the sugar-cane moth borer.

Beginning April 13, Dr. J. Chester Bradley of Cornell University spent seven days in the U. S. National Museum working on the collection of Hymenoptera and discussing a classification of the order with the various specialists. Dr. Bradley is preparing a classification of the Hymenoptera for Professor Comstock's new manual and in doing this he is seeking the co-operation of other workers, with the hope that they will be able to present an arrangement which will be generally acceptable to both American and European workers.

Dr. W. D. Hunter and B. R. Coad of the Bureau of Entomology attended the meeting of the Southern Agricultural Workers, held in Memphis, Tenn., from February 6 to 8. Mr. Coad delivered an address on boll weevil control. The following resolution was adopted at this meeting: "WHEREAS, The Cotton Belt is indebted to the United States Department of Agriculture through its representative, Mr. B. R. Coad, in charge of boll weevil investigation, for an effective method of boll weevil control and for the discovery of important entomological facts concerning the insect pests affecting cotton; Be it *Resolved*, That this Association expresses its high appreciation of Mr. Coad as a scientist and recognizes his invaluable contributions to the cotton industry of the South." Dr. Hunter also attended the meeting of the National Boll Weevil Conference held under the auspices of the American Cotton Association at Atlanta, Ga., February 20, and delivered an addresss on boll weevil control. Both Dr. Hunter and Mr. Coad were in Washington for several days following the Atlanta meeting.

The first issue of "The Canadian Insect Pest Review" appeared on April 3rd. In the "Foreword," it is stated that the object of the Review is; "to present a periodical statement on current insect conditions. It is recognized that it is difficult and sometimes unwise to foretell events relating to insect problems. Nevertheless, a certain security in this regard may be obtained if more consideration is given to the study of meteorological effects and seasonal influences. At any rate knowledge in advance may save thousands of dollars to the farmers, and publicity at the right moment will undoubtedly result in much good." The first issue contains seven multigraphed pages, two of which relate to insect conditions in the United States; this information is furnished by the compiler of the United States "Insect Pest Review Bulletin." The Review has been compiled by Mr. R. C. Treherne, Chief, Division of Field Crop and Garden Insects, from reports received from field officers and collaborators of the Branch. It should prove to be a most useful publication.

Termites are very destructive to the woodwork of buildings and their contents in the United States. Of the 40 species occurring in this country, species of *Reticulitermes* are the most injurious to buildings. In the Southern and Gulf States, however, species of *Kalotermes* and *Crytotermes* are also injurious, and in the Southwestern States species of *Kalotermes* and *Amitermes*, as well as *Reticulitermes*, are injurious. On the Pacific Coast *Reticulitermes* and *Kalotermes* damage buildings. During the

fiscal year 1922, the Forest Insect Branch of the Bureau gave advice in 118 cases in which termites had damaged the woodwork of buildings or their contents in the United States, and during the present fiscal year 74 cases of such damage have already been reported. A destructive species of West Indian termite which breeds in dry solid wood seriously damaged the woodwork and furniture in a large hotel in Miami, Fla. The termites infesting the furniture were killed by placing it in the attic directly under the roof, where the sun's rays beat down. The temperature in the attic was from 17 to 24 degrees F. higher than the maximum temperature recorded by the U. S. Weather Bureau.

During the past year the work of rearing and liberating an important parasite of the corn borer, *Habrobracon brevicornis* Wesmael, has been very successful, and this parasite has been liberated in numbers exceeding 1,000,000 individuals in the densely infested area in New England. In view of the success achieved in rearing this parasite, it was believed that it might be worth while to attempt to introduce it into the intensely infested areas of southern Ontario, and a suggestion to this effect was made to the Dominion Entomologist, Arthur Gibson, who recently has been authorized to employ an assistant for this purpose. With this end in view, A. B. Baird recently visited the Arlington, Mass., laboratory and was instructed in the technique necessary for the handling of this parasite. Mr. Baird will soon proceed to southern Ontario to conduct the preliminary work necessary for the rearing and introduction of this parasite into Canada. Several other promising parasites of the corn borer have been received from Dr. W. R. Thompson,located in France, and are being reared by Detmar W. Jones of the Arlington laboratory. Mr. Jones has shown great ingenuity in perfecting the technique for the successful rearing of these insects, and at least one additional promising species will soon be ready for liberation.

The third general meeting of the North-west International Committee on Farm Pests was held at the Agricultural College, Winnipeg, Manitoba on April 18 and 19 1923, the following entomologists being present: W. R. Walton, Washington, D. C.; Arthur Gibson and R. C. Treherne, Ottawa; Stewart Lockwood, Montana; R. L. Webster, North Dakota; H. V. Severin, South Dakota; A. G. Ruggles, Minnesota; E. H. Strickland and H. L. Seamans, Alberta; Kenneth King and M. P. Tullis, Saskatchewan; A. V. Mitchener and N. Criddle; Manitoba. Some of the sessions were also attended by members of the college staff and by J. B. Wallis, Winnipeg.

The meetings were opened with an address of welcome by Prof. C. H. Lee, acting president of the college and later Mr. J. H. Evans Deputy Minister of Agriculture also addressed the meeting.

The sessions were of an informal nature, no set papers being presented. Important subjects discussed were: The Pale Western cutworm (*P. orthogonia*), grasshoppers and grasshopper baits, the Wheat-stem Sawfly (*C. cinctus*), Hessian-fly, etc.

The committee reported upon experiments undertaken during 1922 and arranged for a uniform series of experiments to be carried on in 1923.

The importance of rainfall as a means of forcing cutworms to the surface and thus enabling parasites to attack them, was brought out, as showing the chief cause in explaining the periodic outbreaks. Cultural methods for preventing egg laying on fields and as a method of possibly destroying the eggs were discussed and a series of experiments arranged in order to obtain fuller information on these subjects.

An extensive discussion on grasshopper baits indicated the necessity of a close

study of temperature in relation to the feeding activities of grasshoppers in order to apply baits at the right time of day. It was also considered desirable to make a close study of other meteorological factors which might influence the insects' feeding habits. A number of uniform tests were arranged to be undertaken in 1923.

The alarming increase of the Wheat-stem Sawfly in Manitoba, Saskatchewan, and Alberta, and its wide distribution elsewhere, were discussed, particular emphasis being placed upon the importance of the larval habit in not cutting the stems until they begin to dry; a habit which enables farmers to harvest their crops in comparative safety by cutting them before they are dead ripe. The apparent failure of parasites to follow the sawfly into the grain crops was also discussed.

A rapid increase of Hessian-fly over certain sections of the spring wheat growing region indicated that a serious outbreak may occur in the near future and it was deemed advisable to make a close study of the insect's habits in the more northern sections of its range. The influence of humidity in relation to development was thought to be of marked importance in accounting for sudden outbreaks after the long periods of inactivity.

It was arranged to hold the next meeting at Bozeman, Montana. Mr. Criddle was reelected chairman and Prof. R. A. Cooley was chosen as secretary for that meeting.

N. C.

Horticultural Inspection Notes

In the course of ship inspection, Mr. Max Kisliuk, Jr., an inspector of the Federal Horticultural Board, located in Philadelphia, discovered a specimen of *Vriesia,* in the nurses' quarters of the United States Hospital Ship Mercy arriving from Guantanamo, Cuba, to be infested with an interesting and apparently undescribed specise of *Thrips*, apparently closely related to *Liothrips*. Incidentally, the plant was aleo infested with mealy bugs, Diaspine scale insects, ants, etc., and some of the leavss exhibited diseased spots.

Mr. Lee A. Strong, Chief of the Bureau of Plant Quarantine of California, reports that the Quarantine Inspectors of California have recently discovered that private railway cars entering that state frequently carry fruits prohibited by existing state quarantines. A recent inspection of some nine private cars resulted in the finding of fruits prohibited entry.

Mr. J. T. Rogers, an inspector of the Federal Horticultural Board stationed in Washington, has been temporarily transferred to New York to assist in the enforcement of the Plant Quarantine Act. On July 1, Mr. Rogers will be stationed at Charleston, South Carolina for the purpose of assisting the Customs Officials at that port in the enforcement of the Plant Quarantine Act.

Mr. Ivan Shiller, who during the past year has been stationed at Del. Rio, Texas, has been permanently transferred to New York City to assist in the inspection of plants and plant product imported under permit.

The Arizona State Commission of Agriculture and Horticulture has recently erected at Yuma a vacuum fumigation plant to be used in the fumigation of citrus plants arriving in that state from California. Some four carloads of such stock were fumigated at the plant in question from March 26 to 31 inclusive. The plants were

fumigated at the rate of one ounce avoirdupois of sodium cyanide per one hundred cubic feet of space with a preliminary twenty-seven inch vacuum, and an exposure of one hour.

Mr. L. R. Dorland, the inspector in charge of the work of the Federal Horticultural Board at Nogales, Arizona, recently visited the ports of Lochiel, Naco, and Douglas, Arizona, for the purpose of conferring with the Customs Officials concerning agricultural importations at those points.

Mr. C. C. Halbedl, who has been stationed at Brownsville, Texas for the past two years assisting in the examination of freight cars and passengers' baggage, recently resigned from the service of the Federal Horticultural Board for the purpose of entering commercial work.

Mr. J. W. O'Brien, a Plant Quarantine Inspector of the Federal Horticultural Board located in New York City, recently intercepted in cooperation with the Customs officials, living larvae of the European Corn Borer in stalks of broom corn contained in passenger's baggage. This material was taken from the baggage of a third-class passenger arriving from Italy who proposed to take it to Missouri. Subsequent to this interception, Mr. O'Brien discovered a similar collection in the baggage of a passenger arriving from Germany.

Professor R. W. Harned reports that the Plant Board Inspectors of Mississippi have recently intercepted a dozen or more different shipments of plants from New Orleans which were infested with the Japanese Camphor Scale, *Pseudaonidia duplex* (Ckll.). Most of these shipments were found in Parcel Post packages arriving at Jackson and Gulfport, although a few were taken in express shipments. In addition to the foregoing, Inspector H. D. Money located at Biloxi, Mississippi, discovered a truck load of Satsuma oranges from Alabama, which were heavily infested with this insect. At the time the discovery was made, many of the oranges had been delivered to stores, necessitating their confiscation and destruction.

The Federal Horticultural Board has recently completed a fumigation house at Laredo, Texas, which will accommodate twenty freight cars at one exposure. This house was placed in operation May 4, 1923 and takes the place of the one which was destroyed by fire July 19, 1922. This is probably the largest building in the world used exclusively for fumigation purposes.

In a recent communication, Professor R. W. Harned reports as follows: "The insect that is being known as *Desiantha nociva*, that was first discovered in Stone County, Mississippi in March 1922, has now been found in five counties; Stone, Harrison, Jackson, Pearl River and Hancock. Last year the insect was only noted as injuring Irish potatoes, although found on several other plants. So far this year, its greatest damage has been done to turnips. It is thought that further scouting will show that this insect occurs in several other counties in South Mississippi, and probably also in Alabama and Louisiana. It has been found close to both of these states.

"The Bureau of Entomology and the State Plant Board of Mississippi are making a desperate fight against the sweet potato weevil in Mississippi. Many conditions have been favorable to the increase of the insect, and although the eradication program has not progressed as rapidly as the authorities in charge had hoped would be the case, the insect has to a very large extent been prevented from spreading. Although a great amount of scouting is being done for this insect, it has so far been

confined to the four counties that were in the original infestation; Jackson, Hancock, Harrison, and Pearl River, except for two properties in George County and one property in Adams County. In each of these cases, the inspectors have been able to account for the infestation. George County became infested through potato sacks that were brought from Pascagoula, Mississippi. The one farm in Adams County became infested by a direct shipment of infested sweet potatoes by express. It is now believed that the weevils have been completely eradicated from the one property in Adams County, and the two properties in George County."

Mr. H. Y. Gouldman, an inspector of the Federal Horticultural Board in Washington, recently intercepted an interesting Balaninus in a small collection of chestnuts received by the Department of Agriculture from China. Mr. Gouldman has also recently collected what appears to be *Ptilinum tropicum* (Matthews) or an allied species in old wood found in a box containing orchid plants from Cristobal, Canal Zone. This is reported to be one of the smallest beetles described in Biologica Centra-Americana.

The fifth annual conference of the Western Plant Quarantine Board has been called for May 21, 22, and 23 at Phoenix, Arizona. This board is composed of the quarantine officers of the eleven western states, British Columbia, Hawaii and the northern district of Lower California. The purpose of the Board is to work toward uniform enforcement of quarantine regulations and to assist in the protection of the West from injurious insects and plant diseases not known to occur in these regions.

Mr. M. J. Kerr, Plant Quarantine Inspector of the Federal Horticultural Board stationed at New Orleans, visited Mobile during the month of May for the purpose of determining from Customs records the volume of the foreign importations of plants and plant products arriving at that port.

Mr. E. S. Jewell and Mr. V. J. Shiner motored from Laredo, Texas to San Ygnacio and Zapata, Texas for the purpose of consulting with the Customs officials and determining the amount of traffic entering the United States from Mexico and the likelihood of the entry of cotton seed and other contraband material at these ports.

Facilities for the sterilization of broom corn are now available at the port of Boston. This is a very fortunate situation, since it will make possible the shipment to Boston for prompt sterilization of broom corn which arrived in New York during the early spring infested with larvae of the European Corn Borer. Although the entry of broom corn is restricted to the months of November to March inclusive, entry of this commodity will be permitted in the future at Boston throughout the year.

Mr. W. M. Mann of the Bureau of Entomology left Washington early in January, and entered Mexico at Nogales, Ariz., to make a special investigation of the fruit fly situation in Mexico for the Federal Horticultural Board.

Mr. W. B. Wood of the Federal Horticultural Board, during the month of February, inspected the plants for distribution at the field stations of the Office of Foreign Seed and Plant Introduction at Savanah, Ga., and Brooksville and Miami, Fla.

Mr. R. D. Kennedy, inspector of the Federal Horticultural Board in Washington, D. C., recently collected what appears to be *Aspidiotus cryptoxanthus* Ckll., on walnut cuttings, and *Lepidosaphes flava* var. *hawaiiensis* (Mask.) on chestnut cuttings from Shantung, China, two scale insects not known to occur in the United States.

Apicultural Notes

Mr. A. I. Root, founder of the A. I. Root Company, Medina, Ohio, and author of the A B and C of Bee Culture died April 30 at his home in Medina at the age of 83 years.

The annual spring meeting of the Connecticut Beekeepers Association was held at the State Capitol, Hartford, on May 5. The association has about 250 members and the following officers were reelected: President H. L. Lankton; Vice-President S. J. Griffin; Secretary-Treasurer, Louis St. Clair Burr; members of executive committee, L. C. Root, J. D. Kroha, H. W. Coley: auditors, A. W. Yates, C. J. Ross.

A new bee disease law has been enacted in Ohio through the efforts of the Ohio State Beekeeper's Association, and carries an appropriation of $5,000.00 for inspection work. The enforcement of this law is in charge of Richard Faxon, Director of Agriculture, who is empowered to formulate rules and regulations concerning the inspection and shipment of bees.

Mr. A. E. Lundie, a graduate student of Cornell University, who is making a special study of beekeeping in this country, preparatory to taking up work in beekeeping for the Union of South Africa, has spent most of the last eighteen months at the bee culture laboratory of the Bureau of Entomology near Washington. D. C. Mr. Lundie has now returned to Cornell to take his examinations for the degree of Doctor of Philosophy, and will soon return to South Africa.

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THE POSSIBILITY OF TRANSMITTING A CALENDRA INFESTATION FROM WHEAT TO MACARONI THRU THE PROCESSES OF MILLING AND MANUFACTURING[1]

By Royal N. Chapman, *Division of Entomology and Economic Zoology, University of Minnesota*

Abstract

The question of whether or not a granary weevil infestation could pass directly from the wheat to the macaroni has been of great practical importance to the milling and macaroni industries. In the experiments described in this paper it was shown that (1) no stage of the weevil could survive the process of milling the durum wheat into Semolina from which the marcaroni is manufactured. Even the eggs were unable to survive this process, (2) that the adult weevils would not oviposit in the semolina, (3) even if the weevils or their eggs were present in semolina they could not survive the process of manufacturing the macaroni. It was also found that the weevils are introduced into the factory and lay their eggs on the macaroni while it is drying.

Introduction

There has been no question that the weevils which attack macaroni are the same ones which attack wheat as cited by Zacker, Cotton, Teichmann and Andres and others, but it has never been determined whether these weevils pass through the processes of manufacture and thus infest the macaroni, or whether the weevils must enter the macaroni in the same way as they enter the wheat, namely by ovipositing in it. The fact that the weevils do lay eggs in macaroni is well known, but their ability to survive the milling of semolina and the process of manufacturing macaroni has been the object of these experiments.

The possibility of the weevils surviving the milling process is dependent upon the ability of the eggs to remain unbroken during the process of milling. Since these eggs are slightly smaller than granules of No. 2 semolina, it is a question as to whether the wheat would break in such a way as to leave the egg in the center of a granule. This is a matter of the chance of a granule breaking off without the line of cleavage following the cavity in which the egg was laid.

[1]Published with the approval of the Director as Paper No. *147* of the Journal Series of the Minnesota Agricultural Experiment Station.

The matter of the weevils passing through the macaroni press depends upon how much pressure the egg could withstand while in the dough. Further than this the egg must of course have remained unhatched from the time when the wheat was milled until the semolina was made into macaroni, unless the weevils were in the semolina and laid their eggs there. All of these questions were taken into consideration in the following experiments.

Part of the work was done at the North Dakota Agricultural Experiment Station because of its facilities for milling semolina. The making of the macaroni was done at a factory in Minneapolis. The rest of the work was done in the laboratories of the Division of Entomology at the Minnesota Agricultural Experiment Station. Every step in these experiments was under the personal supervision of the author from the time the wheat was first obtained until the macaroni had been made and given careful examination. This supervision included transportation of the wheat to Fargo, milling, return of the semolina to Minneapolis, and the manufacture of the macaroni as well as all the work done at the University.

Literature

The possibility of transmitting an infestation of Calendra from wheat to the various hard products manufactured from it, seems to have been left unmentioned in the voluminous literature written on the subject. Zacher, 1918 figures a photograph of[2] *Calendra granaria* attacking macaroni. Cotton, 1920, describes *Calendra oryzae* as attacking macaroni and Teichmann and Andres also list macaroni as among the food attacked by *Calendra granaria*. Durant, Hartley, and Beveridge, 1913 state that they found both *Calendra granaria*, and *Calendra oryza* infesting army biscuits. In the case of these authors it was shown that the weevils must have infested the product after it had been baked. With the exception of this one reference, no reference was found to the possibility of these weevils surviving the process of milling or any of the various processes of manufacturing food products from flour.

Doane, 1918, states that he has found *Calendra granaria* on and in sacks of flour but no statement is made as to whether these weevils entered the flour after milling or not. Furthermore there is no statement as to whether or not these weevils oviposited in the flour.

[2]The generic name *Calendra* was retained in this manuscript altho *Sitophilus* now seems correct.

Experiments with the Milling

Two sets of experiments were performed to determine the possibility of the granary weevils or their eggs surviving the process of milling. Macaroni, spaghetti and other allied pastes are commonly manufactured from semolina, a coarse product from durum wheat. The coarseness of the product varies with the grade and the grades in turn vary from mill to mill. However, the semolina may, in a general way. be compared with the farina of other wheats and it varies from the very coarse "No. 1" to the finer "No. 3," the "No. 2" being the coarsest grade commonly used in making macaroni.

The first set of experiments was conducted with the ordinary methods used in milling semolina on a commercial basis. Twenty bushels of wheat were obtained, which was inspected by the North Dakota state grain inspection laboratory and graded as mixed durum, containing 83 per cent amber durum, 6 per cent red durum, and 11 per cent hard red spring wheat.

The wheat was tempered on January 25, 1922 to bring its moisture content up to 14 per cent which has been found by Dendy and Elkington to be about the optimum moisture condition for development. On the following days adult granary weevils (*Calendra granaria*) were added as rapidly as they could be obtained until the wheat contained an average of 2 weevils to the ounce. The wheat was then kept in 3 covered galvanized iron tanks at a temperature of about 75° F. On January 28th all the weevils had been added and on January 30th many of the weevils were mating.

Samples of wheat were examined daily from this time on and feeding punctures and eggs were found in increasing numbers as time passed. On February 12th, 1922 the percentage of wheat berries infested with eggs had risen to about four. Some of the eggs had hatched but the majority had been laid recently. The wheat was then sacked and shipped from Minneapolis to Fargo where the experimental mill was equipped for the milling of semolina. A sample of one-half bushel of the wheat was kept at Minnesota for a check on the experiment. The wheat was carefully guarded during transit to prevent it from being chilled and when it arrived at the mill the temperature in all of the sacks averaged 59.9° F and the weevils were alive and active.

A check sample was taken out and the remainder was tempered to 15 per cent of moisture and milled on the following day. The adult weevils were removed by screening the wheat and about 300 pounds of No. 2 semolina and about 50 pounds of No. 1 semolina were obtained.

The finer granulations were disregarded because they would be finer than the weevil eggs, consequently the only chance for the eggs to survive would be in the coarser granulations. Pl. 4, fig. 1 is a photograph of a weevil egg surrounded by granules of number two semolina.

The semolina together with the unmilled sample was returned to the Minnesota Agricultural College. The same precautions for protecting the material from the cold were observed as before and the average temperature of the semolina was 61.2° F when it arrived. The weevils in the check samples of unmilled wheat were alive and active.

On February 17th, 1922, 150 pounds of the semolina was made into macaroni as will be described later.

The second milling experiment was performed in a small laboratory mill in the Division of Agricultural Biochemistry at the University of Minnesota with a peck of the sample of wheat which had been retained as a check. This wheat was infested with more weevils from time to time until March 30th. At this time the wheat contained all stages of the weevil; the eggs, larvae, pupae, and adults ready to emerge. Ten wheat berries were selected, each of which contained an egg, and these were milled separately. The peck of wheat was milled first and small samples of material were removed after each grinding to determine to what extent the various stages of the weevils survived. This was to determine whether or not the wheat berries had a tendency to fracture along the egg cavity. Since the possibility for the survival of the egg depends upon the granules breaking off in such a way as to include the eggs within them, a tendency for the wheat berries to fracture along the egg cavities would greatly reduce the possibility for the eggs to survive. In the larger sample, it was found that over 50 per cent of the adult weevils survived the first set of rolls. An examination of the material from the 10 berries showed that only two of the egg cavities could be located and these were in the bran. In one case it could be seen that the inner part of the wheat berry had broken along the egg cavity and the egg could not be found.

No living stages of the weevils were found in the middlings from the first separation although there were many broken parts of legs and other structures of the adult beetles. After the second break a few living weevils were found but after the third break there were no survivors to be found. Samples of material were kept and examined from time to time, but there was no evidence of living eggs.

From the above it is shown that no stages of the weevil survived the

process of milling semolina in these experiments, although the wheat was heavily infested.

Oviposition in Semolina

Many descriptions of the food of the adult weevils include flour as a food substance without distinguishing between substances in which they may sustain life for a certain period and those in which they may live, reproduce and otherwise function in a normal way. Consequently it was necessary to determine whether these weevils might oviposit in the absence of a material too small in size for the construction of the ordinary egg cavity. Three samples of No. 1 and No. 2 semolina were placed in jars and infested with 100 weevils, in each case. The samples were then examined every other day for a month, but there was no evidence of any eggs having been laid and the adults died without leaving progeny. Other weevils taken from the same culture were placed in wheat during this same period of time and they oviposited normally the eggs hatched and the larvae came to maturity. Another 15 pound sample of No. 1 semolina was infested and left to be made into macaroni as will be described later.

In order to determine whether larvae might develop in small granules in case eggs did pass thru the mill or the adults did at times oviposit in granules, particles of wheat were chipped out by hand in such a way that eggs were left in small granules. In these cases the larvae soon broke out of the granules when the inside of them had been consumed. These larvae died due to the fact that they have no legs and were not fitted for life outside of a hard substance. This confirms Cotton's[2] statement that the larvae are restricted to seeds or other foods which contain sufficient food to enable them to develop to maturity. Cases have been observed in which the adult weevils have oviposited in very thin ribbon like noodles. In such cases the adults are apparently deceived by the third dimension of the material. In these cases the larvae either develop into very small adults in case the noodles are thick enough to permit it, or they break out of the material and perish. In such thin material the larval cavity takes on the character of an elongated mine rather than the more or less spherical shape characteristically found in wheat and other grains. This is doubtless due to their reaction when they approach the surface of the material within which they are confined.

This leads to the conclusion that adult beetles could not be induced

[2]Cotton, R. T. 1920. Page 410.

to lay eggs in the semolina. In addition to this it was found that the larvae could not develop in granules like those of semolina even when experimentally placed in such a situation.

The Process of Manufacturing Macaroni

A macaroni press of the ordinary hydraulic type was used in these experiments and the pressure was set to remain between 1,000 and 3,000 pounds per square inch. The factor of pressure as it is concerned in this case is not one of a uniform distribution through the dough. Since only a small percent of the area of the die is perforated, the majority of the dough can not move directly down the cylinder and thru the perforations but must move to the side to be crowded thru the opening. This surging about in the press and readjusting is doubtless the most severe part of the process.

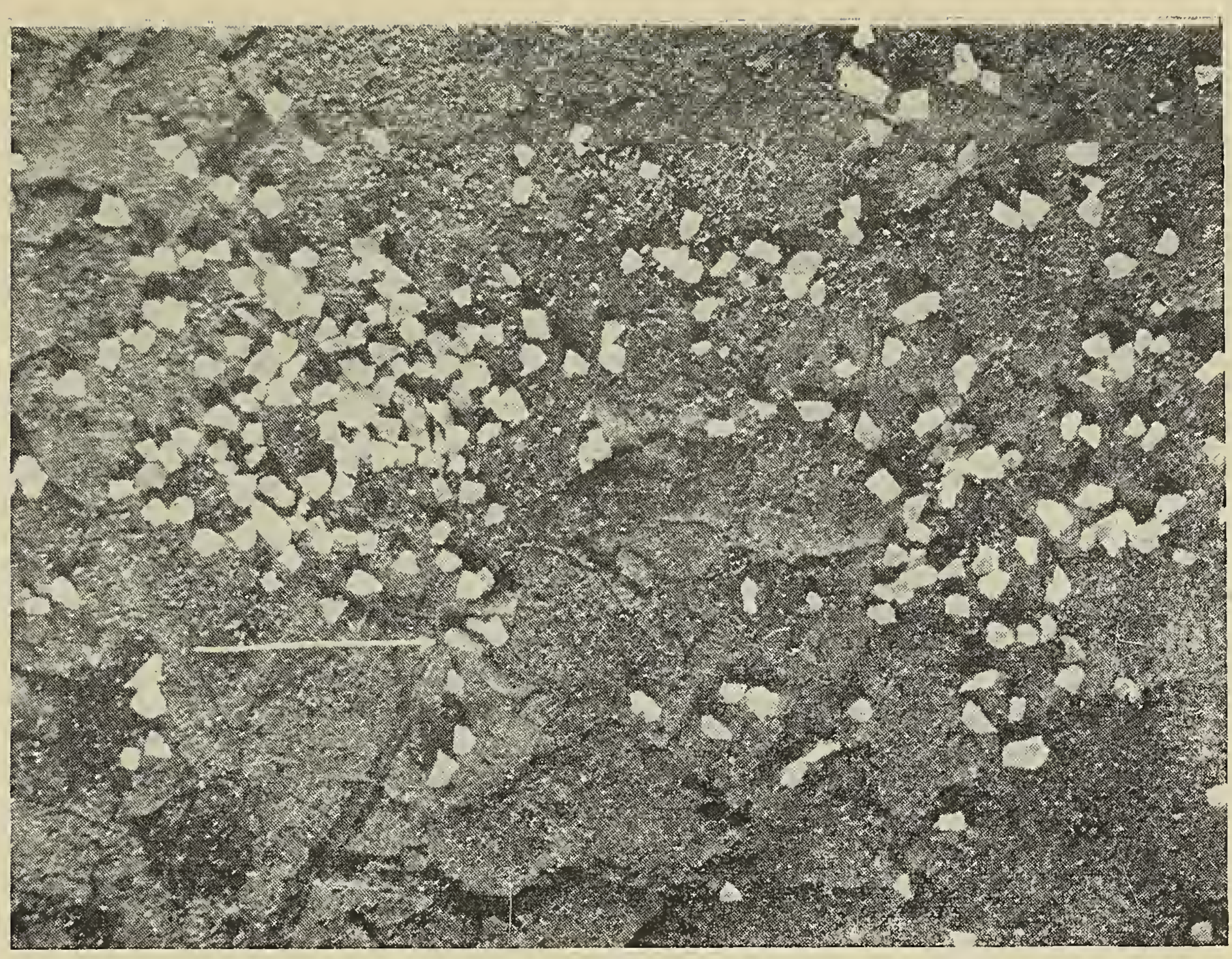
The first experiment was performed on February 17th, 1922, 3 days after the semolina was milled. During the time between the milling and making the macaroni the semolina was kept at a temperature of about 75° F. The dough was mixed in an ordinary dough mixer. The temperature of the water used was 145° F and after 10 minutes mixing the temperature of the dough was 102° F.

The dough was then kneaded, rolled and pressed. Samples were taken after each operation for examination. In one lot the eggs of the confused flour beetle (*Tribolium confusum*) were placed in the dough just before it was put into the press to determine what effect the pressure would have on these eggs. It was not possible to use the eggs of the granary weevil in this case because they were difficult to obtain free from the wheat. The eggs of the confused flour beetle as described and figured by Chapman, 1918, are of more regular shape than those of the weevil and consequently should withstand greater pressure. Teichmann and Andres describe and figure the egg of the *Calendra granaria* as regularly ovid. Cotton described the eggs of *Calendra oryzae* as varying from ovid to pear-shaped conforming to the shape of the cavity. Hinds and Hunter figure photographs of the eggs of this species showing the general ovid shape. The examination of the eggs of *Calendra granaria* has shown that they vary in shape much like those of

1. Egg of *Calendra granaria* compared with semolina granules. Egg indicated by arrow.

2. Intact eggs of *Tribolium confusum* compared with eggs which have passed thru a macaroni press. Intact eggs at the left and crushed eggs at the right.

3. Macaroni containing parts of *Tribolium confusum* which were crushed in the press. Intact beetles are shown at the left.



1

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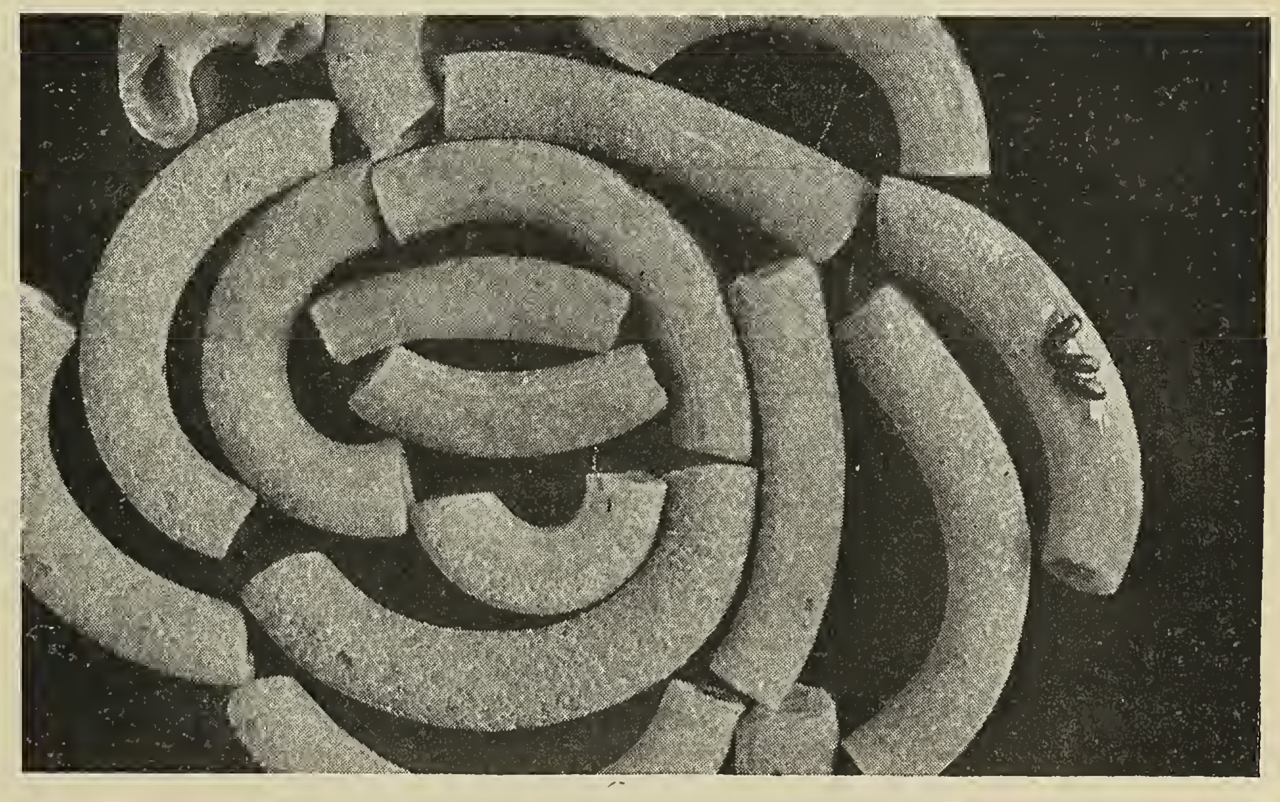

3

Calendra oryzae and are not always as regular in shape as Teichmann and Andres describe them.

The macaroni was made into short goods about one inch and a third long. Part of it had a wall thickness of 1/16 inch and the rest about 1/24 inch. The drying was done on trays along with other macaroni in the factory. The air in the drying room was 80° F and the process required 20 hours.

As stated before, samples of dough were taken after each operation and undried macaroni was taken out after each lot had been pressed. These fresh samples were examined the same day but no evidence was found of live eggs of either the confused flour beetle or the granary weevil. The dried macaroni was then examined microscopically and carefully broken apart. The remains of the confused flour beetle eggs were found broken and drawn out of shape and embedded in the walls of the macaroni as illustrated in the photograph Plate 4, fig. 3.

The entire amount of macaroni was kept in carefully sealed cans under the same conditions as the check samples of wheat, one of which had been kept at Minnesota and the other of which had been shipped to Fargo and back. During the last week in March adult beetles were emerging from these check samples of wheat showing that the eggs which had been laid in the wheat had developed and that nothing connected with the experiment had affected them. At this same time the entire amount of macaroni was carefully examined but there was no evidence of weevils in any of it.

The second lot of macaroni was made March 31 in the same way as the first with the following exceptions: the No.1 semolina which had been infested with adult weevils was sifted to remove the adult beetles but to leave in any of the eggs which might have been laid. This and the small amount of semolina which had been milled at the University of Minnesota the previous day from wheat which was known to contain many eggs, was mixed with the remainder of the semolina from the first milling.

When the last lot of dough was about to be put into the press a larger number of eggs, larvae, pupae, and adults of the confused flour beetle was placed in it. Some of this macaroni was collected and examined within a few hours. The rest was dried as before. Upon examination parts of the flour beetles were found, but all were very small and no eggs or other stages were found to be intact (Pl. 4, fig. 3). Furthermore the parts of the beetles were distributed throughout this lot of macaroni showing that the dough surges about in the press.

All of the macaroni was examined after drying but no evidence of live insects had been found even though the macaroni had been kept under observation and carefully examined from time to time.

Conclusions

In the above experiments no stages of the granary weevil (*Calendra granaria*) survived the process of milling semolina even though the wheat was very heavily infested.

The adult beetles did not lay eggs in the semolina even though left in it until they died.

When parts of the wheat were cut away experimentally leaving the eggs in granules similar to those of semolina, the larvae were unable to develop. This is the condition which would arise if eggs did pass through the mill in such granules.

None of the macaroni made from the infested semolina was infested with any insects or eggs even though all the semolina came from badly infested wheat. Part of the semolina had contained adult weevils, and some of the dough had all of the stages of flour beetles placed in it just before it was pressed into macaroni.

This means that macaroni contains no living insects or eggs in any stages as it comes from the press. This is in spite of whether the wheat or flour or semolina may have contained weevils or flour beetles.

Literature Cited

Chapman, Royal N.
1918. The confused flour beetle (Tribolium confusum Duval) 17th Rept. State Entomologist of Minn., St. Paul, 73–94.

Cotton, Richard T.
1920. Rice weevil, (*Calandra*) *Sitophilus oryza*. Jour. of Agri. Research 20: 409–442.

Dendy, Arthur and Elkington, H. D.
1920. Report on the vitality and note of multiplication of certain grain insects under various conditions of temperature and moisture. Royal Soc. Repts of the Grain Pests (War) Committee. No. 7. London.

Doane, R. W.
1918. Some problems in the control of insects in stored foods in California. Jour. of Econom. Zoology. 11: 315.

Durant, J., Hartley and Beveridge, W. W. O.
1913. A preliminary report of the temperature reached in army biscuits during baking, especially with reference to the destruction of the imported flour moth, *Ephestia Kühniella* Zeller. Jour. of the Royal Army Medical Corps. 20: 615–634.

Hinds, W. E. and Turner, W. F.
1911. Life history of the rice weevil in Alabama. Jour. of Econom. Entomol. 4: 230–236.

Teichmann, Ernst and Andres, Adolf.
1919. *Calandra granaria* L. and *Calandra oryzae* L. als Getreideschädlinge. Zeitschrift für angewandte Entomologie. 6:1–24.

Zacker, Dr. Freidrich.
1918. Vorratsschädlinge und ihre Bekämpfung. Kaiserliche Biologische Anstatt für Land. und Forstwirtschaft. Flugblatt Nr. 63.

SPREAD OF THE JAPANESE BEETLE, *POPILLIA JAPONICA* NEWM.

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Abstract

The area of infestation by the Japanese beetle has increased from less than one square mile in 1916, when it was first discovered in Burlington County, New Jersey, to 773 square miles at the end of the 1922 season, comprising adjacent portions of Pennsylvania and New Jersey.

It is believed that the spread to date is largely a natural spread on the part of the insect, by means of flight in search of food and suitable breeding grounds. Winds, storms, and waterways are also factors of some importance in the natural spread of the insect.

Artificial agencies are important factors affecting the dispersion of the insect, especially the movement from infested areas of farm products, particularly sweet sugar corn; vehicles of all kinds, and pedestrians traveling through heavily infested districts are also important means of at least local dispersion.

The shipment of infested nursery stock originating in heavily infested portions of the territory is probably the most important means of long distance dispersion of the insect, and this is being guarded against by stringent quarantine regulations.

The Japanese beetle, (*Popillia japonica* Newm.), was first found near Riverton, in Burlington County, New Jersey, in the summer of 1916. Previous published accounts[1] have described the development of the insect from that time, and the work being carried on at the Japanese beetle laboratory. Seven years have elapsed since the original finding of the insect in this country and the data now at hand are sufficient to allow the drawing of certain conclusions as to the spread of an imported insect in a new environment, under the conditions obtaining in the present case. It is the object of this paper to indicate the spread of the insect during the period mentioned, and to discuss briefly some of the factors primarily responsible for the dispersion which has taken place. The data are drawn from the scouting records compiled each year at the Japanese beetle laboratory, and from the personal observation of the writers and other members of the laboratory force.

Yearly Spread

In 1916, the area found to be infested was very small, estimated to be less than 1 square mile in extent. At this time, the beetles were first found feeding on the tips of Crataegus. It was assumed to be a Southern species and no particular efforts were made to determine the limits of the area infested. However, the fact that comparatively few beetles were found, would indicate that the area infested was relatively small, certainly not over the figure given above.

In 1917 a considerable area was scouted and the infestation found

[1]Davis, J. J. N. J. Dept. Agric. Circ. 30, 1920.
Hadley, C. H., N. J. Dept. Agric. Circ. 46–1922.

to cover an area approximately 2.7 square miles in extent, of which about .5 square mile was heavily infested.

In 1918 more intensive scouting was carried out and the infestation was found to have increased to such an extent as to cover an area of approximately 6.7 square miles, as measured on the map. Up to this year the numbers of the insect were still comparatively small, and the spread not to be considered especially extensive in comparison with the spread of later years.

In 1919 the numbers of the insects in the heavily infested area had increased to a point where in the centre of the infested territory, beetles could be found in what may be considered decided abundance. During the summer of 1919, the spread was considerable, and a total of 48.3 square miles was found to be infested. Up to and including this season, no Japanese beetles had been found across the river in Pennsylvania, the entire infestation still being confined to New Jersey.

In 1920 there was again a large increase in infested territory, and for the first time beetles were found across the river in Pennsylvania. It is probable, however, in view of the numbers found there during this season, that the insect had actually reached the Pennsylvania side of the Delaware river during the preceding season, (1919) but in numbers so small as not to have been observed in the scouting of that season. At the end of 1920, the infested area in New Jersey was 92 square miles, and in Pennsylvania 11 square miles, making a total infested area of 103 square miles.

In 1921 the greatest outward spread up to that time occurred. During the summer of 1920, and to a less extent during the preceding summers, strenuous efforts had been made to prevent the spread of the insect, by a program of dusting and spraying around the infested area. However, the spread which occurred, especially during the seasons of 1919 and 1920, had seemed to show that repressive measures as followed were not sufficiently effective to justify their continuation. During the summer of 1921 the beetles had increased in numbers to a very marked extent, and there was an increase in infested area probably in direct proportion to the increase in density. At the end of this season, the infested area in New Jersey amounted to 213.5 square miles, and in Pennsylvania 56.5 square miles, a total of 270 square miles all told.

During the season just passed, that of 1922, there again has been an increase both in density and area of infestation, more or less in direct proportion. The spread has been fairly general in all directions, and

gives now a total of infested area, including portions of both Pennsylvania and New Jersey, amounting to 773 square miles.

Factors Primarily Responsible for Dispersion

Natural Agencies of Dispersion. It is believed that the spread to date is probably largely due to natural agencies. This belief is based on the fact that the rate of spread, year by year, has been fairly constant, in comparison with the increase in numbers of the insects for each year over the previous year. The average yearly rate has been between 5 and 10 miles outward.

The flight of the beetle is probably the most outstanding natural agency of dispersion. The beetle is a strong and vigorous flyer, and is especially active during the hot summer days. Beetles will fly from tree to tree and probably from place to place for some distance in search of suitable food. Early in the beetle season suitable food is in abundance. As the season progresses, and the defoliation of suitable food plants becomes more complete, there is apparently a tendency for the insects to range further in search of food. While it is not possible to say definitely the greatest distance which an individual beetle can fly, experiments have been conducted in connection with this point, during the course of which marked beetles have been recovered at least a mile and a quarter away from the point of releasement. It is not supposed that this distance was covered in one single flight, but more probably in a series of flights. Flight also occurs in the search for a suitable place for deposition of eggs by the female, and it has been noted also that males will accompany females to a certain extent on these occasions. Probably, however, the distance travelled on such occasions is less than when the insects are in search of food.

Dispersion of the insects by winds and storms is probably not an important factor. While it may be true that a few beetles may be carried some distance by strong winds, it has also been noted that normally beetles will fly against rather than with the wind. This fact would tend to limit the distance of flight rather than to increase it.

It is possible that waterways are factors of some importance in the dispersion of the beetle. For example, individual beetles have been picked out of the water of the Delaware River where it flows through the infested territory, at a distance of several hundred yards from the infested shore line. Experiments have shown that the beetles are quite well able to float in water with the current, unless seized by fish or birds. It is quite possible that some beetles may have been carried some dis-

tance in this manner, especially along the smaller streams flowing through the infested territories.

Dispersion by Artificial Agencies. Undoubtedly artificial agencies have played an important part in the local dispersion of the insect. For example, during the inspection of sugar corn, prior to the corn being carried to the market, many thousands of beetles have been removed from the ears of corn. Very often beetles have been found in the husks of the ear, in positions such as to practically insure their carriage, at least to the market where the corn is deposited, unless they have been removed by hand. Beetles have also been found in baskets and other containers in which produce is shipped from the infested area to the market.

Passing vehicles also afford a means of artificial dispersion of the insect, but probably not over as great distances as by the means mentioned in the preceding paragraph. There are many records of findings of beetles on vehicles of all descriptions passing through the infested territory. This fact has also been proven experimentally, as follows: a truck was covered with coarse mesh screen wire, which was smeared over with tanglefoot, and along the sides of which was fastened a trough, also smeared with tanglefoot. During the summer of 1921 this truck was driven over a part of the roads through both the heavily and lightly infested areas; many beetles were caught by the tangle foot on the wire and along the trough, indicating clearly that many beetles would have fallen in the truck had it not been covered by the wire.

The movement of humans on foot in and through heavily infested fields may also result in the artificial dispersion of the insect locally. For example, beetles have been removed from the clothing of men working in infested orchards after they have left the orchard; beetles have also been removed from the clothing of pedestrians walking along the roads and paths, or through fields, in the heavily infested districts.

Artificial dispersion over long distances is most apt to result from the shipment of infested nursery stock. All evidence at hand seems to show beyond reasonable doubt that the original infestation in this country resulted from the importation of stock from Japan, namely iris or azalea, with the soil about the roots, infested with the larval stage of the insect. Several similar cases have come to the attention of the writers, where imported stock of this character has been found, upon examination, to carry living larvae of Anomala or other related groups. Experience with nurseries located in the beetle infested area has shown that stock commonly shipped with soil around the roots, such as potted

stock and the various conifers, can very easily carry living larvae in the soil and matted roots to any distance over which the stock itself can be safely shipped. Stringent quarantine regulations affecting the shipment of nursery stock from infested territory have been, for several years, and are now being enforced by the Quarantine division of the Japanese beetle laboratory staff; so far as is now known, these regulations have been effective in preventing further dispersion through this means.

THE EFFECT OF LEAF-HOPPER INJURY ON THE SUGAR-CONTENT OF GRAPES

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Abstract

The grape leaf-hopper, *Erythroneura comes* Say, is a major pest in the vineyards of the Pennsylvania grape belt along Lake Erie. During seasons of high leaf-hopper infestation, the grapes do not ripen properly. This condition seriously reduces the market value of the grapes for table use and for the manufacture of juice. The extension department of Pennsylvania State College is furnishing a spray service to the grape growers for the control of vineyard insects and diseases under the direction of the author. The effect of a nicotine spray on the leaf-hopper, under the high leaf-hopper infestation found during the season 1922, was determined by a comparison of the sugar-content of grapes (as indicated by the Brix spindle) that received the nicotine spray with grapes that were not sprayed. The conclusion is that, in a season of severe leaf-hopper infestation, a nicotine spray applied to the vines during the period when the maximum number of nymphs of the first generation of leaf-hoppers are present, will permit the production of grapes of table quality. The work also demonstrates that the sugar-content of the grape juice, under conditions of high leaf-hopper infestation, is an index to the efficiency of the control measure.

The primary injury to grapes by the leaf-hopper, *Erythroneura comes* Say, is the effect upon the quality of the product. Fruit from vines infested with leaf-hopper is low in sugar content, inferior in flavor, and improperly colored. Such grapes are not suitable for the table-grape market and are not wanted at the grape-juice factories. If any large proportion of the production is of such quality, the crop moves slowly at a low price. In a season of high leaf-hopper infestation the production of grapes of table quality depends upon efficient leaf-hopper control.

There are numerous records relating to the effect of leaf-hopper injury upon the quality of grapes. Harris, 1841, (1) refers to the exhaustion of grape vines by the continued interruption of the important functions of the plant due to the feeding of the leaf-hopper. Slingerland, 1904, (2) states that leaves badly injured by the grape leaf-hopper die permaturely, thus preventing the proper coloring, ripening and sweeten-

ing of the fruit. Hartzell, 1910, (3) calls attention to the non-ripening of grapes and their poor quality due to leaf-hopper infestation. Johnson, 1911, (4) says that foliage badly injured by the grape leaf-hopper cannot elaborate the sugar of the fruit. Hartzell, 1912, (5) further considers the nature of the injury to grapes by the leaf-hopper as indicated by the quality of grapes from infested vineyards, and in 1913, (6) reports on analyses of grapes from vines sprayed with nicotine and from non-sprayed vines. Johnson, 1914, (7) again refers to the arrested functioning of the foliage by injury due to the grape leaf-hopper and says this has a tendency to check the development of the entire vine, the size of the crop of fruit is reduced and the quality is rendered inferior by a reduction of the sugar content. DeLong, 1922, (8) referring to grape leaf-hopper injury in Erie County, Pennsylvania, says that many growers were refused markets for their grapes in 1920 on account of the red appearance and the sour flavor of the partially ripened fruit.

In the report by Hartzell in 1913 he considers that the most important loss to the grape growers from leaf hopper injury arises from a depreciation of the quality of the fruit, that Concord grapes normally have a bluish-black color when ripened but that fruit from leaf-hopper infested vines has a red appearance, a decided lack in flavor, and shows a decrease in sugar content and an increase in acid. He found by analyses a consistent gain in sugar content of grapes from a series of plots sprayed with nicotine as compared with grapes from non-sprayed vines. This increase in the sugar content, due to the control of the leaf-hopper varied from a minimum of 8.4% to a maximum of 68.1%. The increase in the sugar content of the grapes from the sprayed vines varied directly with the amount of leaf-hopper infestation, the lower increase being from vines less infested. The grapes from the vines protected from leaf-hopper injury had a higher sugar content, a lower percentage of acid and a darker color than those grown under identical conditions but subjected to the leaf-hopper attack.

The high leaf-hopper infestation throughout the vineyards in the Pennsylvania section of the grape belt this season emphasized the need of control measures for this insect. A nicotine spray was included in the spray service of the College. This was applied on six demonstration plots in typical locations throughout the section at the time the maximum numbers of nymphs of the first generation were on the vines. It consisted of ½ pint of nicotine sulphate 40% to 100 gallons of water, with either resin fish-oil soap (3 pounds) or lime (10 pounds), and was

applied to the under sides of the leaves under strong pressure. The plots were sprayed July 17th to 19th, inclusive.

In the grape section under consideration, there was an average infestation of 64.25 leaf-hopper nymphs per leaf on the maximum infested vines, including both upper and lower leaves, at the time the nicotine spray was applied. Twenty-four hours after the nicotine spray was applied, a count of tagged companion leaves on all the plots gave an average of 18.37 nymphs per leaf, a reduction of 71.40% in the numbers due to the nicotine spray.

The analyses of grapes made by Hartzell in 1913 suggested to the writer that the sugar content of the grapes in the demonstration plots receiving the nicotine spray, would be an index to the efficiency of this control measure. Readings by the Brix spindle were taken of the juice from composite samples of grapes from all the plots. The amount of nicotine and the time of application were the same for all the plots. There was a variation in the method of application, in the amount of leaf-hopper infestation, in the pressure maintained, in the extent of vine growth, and in the height of the foliage on the wires above the ground. The composite samples were taken (1) from the portions of the plots indicating maximum leaf-hopper infestation, and (2) from portions a reasonable distance from such locations. In addition to the composite samples from each of the plots, selected samples were taken from vines showing the best production and condition of the fruit. The following table gives the results of the Brix readings of the juice from the grape samples taken from the six plots.

Table I. Brix Readings, Nicotine Sprayed Grapes, Concord Variety

Vineyard	Brix Reading.			
	Composite samples.			Selected samples.
	1st.	2nd.	Average.	
Luce	17.89	15.77	16:83	17.94
McCord	16.19	17.29	16.99	17.39
Southwick	17.99	17.67	17.83	19.07
Bostwick	16.87	19.07	17.97	17.97
Pierce	19.07	19.27	19.17	20.17
Bernet	19.87	20.27	20.08	19.57
Average of totals.	18.06	18.22	18.14	18.68

The above readings indicate a sugar content well above the requirement for grapes of table quality. The color of the grapes varied from dark-blue to blue-black. The average reading for the composite samples was 18.14 and the average reading for the selected samples was 18.68, showing only a slight difference in the quality of the grapes taken at random in the more infested portions of the vineyards and in those selected for their good appearance and condition.

The demonstrations do not show what would have been the quality of the grapes had the nicotine not been applied to the vines. Such a contrast is given in the analyses of Hartzell in 1913 between the sprayed and non-sprayed grapes in his series of experiments. His comparisons apply only to the seasonal conditions under which his experiments were carried out.

An opportunity was offered for a comparison in the Erie County work this season. In one vineyard, apart from the demonstrations, a block of grapes did not receive the nicotine spray while a block directly across the alley was sprayed with the same outfit used in the treatment of one of the demonstration plots. All the conditions in the sprayed and unsprayed blocks were otherwise identical. At harvest time samples from the sprayed and non-sprayed vines gave the following readings of the Brix spindle.

TABLE II. BRIX READINGS, SPRAYED AND NON-SPRAYED GRAPES, CONCORD VARIETY

Janes vineyard.	Brix Reading			
	Composite samples			Selected samples
	1st.	2nd.	Average	
Sprayed	18.67	16.87	17.77	18.44
Unsprayed	13.69	14.29	13.99	15.79
Difference	4.98	2.58	3.78	2.65

In the average readings of the composite samples of sprayed and non-sprayed grapes there is a difference of 3.78, which indicates an increase of approximately 27.01% in the sugar content due to the control of the leaf-hopper by the nicotine spray. The season was very favorable for ripening the grapes but the color of the grapes from the non-sprayed vines was reddish purple while those from the sprayed vines varied from dark-blue to blue-black. The results of these comparative readings show that the high sugar content on the demonstration plots was due to leaf-hopper control and that the sugar content of grape juice,

under conditions of serious leaf-hopper infestation, is an index to the efficiency of the control measure..

REFERENCES

1. 1841. HARRIS, T. W. Report on the insects of Massachusetts injurious to vegetation, Cambridge, 1841, pp. 182–185.
2. 1904. SLINGERLAND, M. V. The grape leaf-hopper, *Typhlocyba comes* Say, Cornell University, Expt. Sta. Bul. 215, 1904, p. 86.
3. 1910. HARTZELL, F. Z. A preliminary report on grape insects, N. Y. Expt. Sta. Bul. 331, 1910, pp. 569, 570.
4. 1911. JOHNSON, FRED. Spraying experiments against the grape leaf-hopper in the Lake Erie Valley, U. S. Bur. Ent. Bul. 97, pt. 1, 1911, p. 2.
5. 1912. HARTZELL, F. Z. The grape leaf-hopper and its control. N. Y. Expt. Sta. Bul. 344, 1912, pp. 33, 34.
6. 1913. HARTZELL, F. Z. The grape leaf-hopper, N. Y. Expt. Sta. Bul. 359, 1913, pp. 46–51.
7. 1914. JOHNSON, FRED. The grape leaf-hopper in the Lake Erie Valley, U. S. Dept. Agri. Bul. 19, 1914, p. 5.
8. 1922. DELONG, D. M. The boom nozzle system and the traction duster as factors in grape leaf-hopper control. Jl. Ec. Ent. Vol. 15, No. 1, 1922. p. 88.

A HOUSE FLY PLAGUE IN THE AMERICAN EXPEDITIONARY FORCE[1]

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ABSTRACT

The house fly became a serious danger to health during the summer of 1918 at one of the camps of the 20th Engineers (Forestry) at Lamanchs, Department of the Landes, southwestern France. A location that should have been unusually healthful was transformed into a place of pestilence through neglect of sanitation. A severe epidemic of dysentery was followed by epidemic influenza and pneumonia, and there is strong evidence to support the belief that the fly-borne dysentery was largely responsible for the severity of the influenza among the main body of troops at Lamanchs. Although commissioned entomologists would have encountered substantial difficulties, it is felt that a great deal of good would have been accomplished by qualified men applying preventive and remedial measures at the proper time.

During the year 1918 the writer had an opportunity to observe the lack of fly control in one of the permanent camps of the A. E. F., in the southwest of France. The company of which he was a member (11th Company, 20th Engineers, Forest) went into permanent camp at a spot known as Lamanchs, three miles north of the small seacoast town of Mimizan-les-Bains (Landes) on January 27th. Lamanchs is about in the center of the sand dune belt which borders the Bay of Biscay for nearly 100 miles, the belt being six miles wide at that point. The dune

[1]The facts given are from memory and from the diaries of Attorney F. A. Lind, Seattle, Wash., (formerly first sergeant), and the writer. The substance of this paper was written in 1920 and at that time copies were submitted to Mr. Lind and to Mr. C. T. Dodds, now entomologist with the United Sugar Cos., Los Mochis, Sinaloa, Mexico, and the writer is indebted to both for criticisms and corrections. Mr. Lind and Mr. Dodds were active in studying the causes and possible palliative measures in connection with the fly plague.

region was afforested early in the nineteenth century and today presents perhaps the world's finest example of afforestation, having been converted from an encroaching waste of sea sand to a profitable area yielding turpentine, lumber and fuel. Here a number of units of American forest troops found supplies of suitable timber sufficient for many months' operations.

The camp site at Lamanchs is ideal from the standpoint of health and sanitation. The drainage in the dry sand is perfect. There are no streams or pools of standing water in the entire local dune region and mosquitoes are rare. Excepting one farmhouse two miles to the west there is no human habitation nearer than Mimizan-les-Bains. The climate is mild, the rains occurring mostly during the winter months, and snow seldom falls. The heat of summer is moderated by steady winds from the sea. Very little of the area is level and a uniform stand of maritime pines covers the dunes which consist of long ridges parallel to the coastline, and which attain a maximum height of 100 feet at their crests. Lamanchs was uninhabited before our arrival, being merely a loading point for lumber and turpentine on a branch of the Southern Railroad.

After some weeks, sanitary arrangements for the company's camp were installed—shower baths, a covered mess hall and kitchen combined, incinerator, a driven well, and a meat storage house. During the first months open latrines were used, followed by the erection of a large box latrine about May 1st, in accordance with general orders received. The covered latrine consisted of a pit about 30 x 6 feet and 8 feet deep, covered with a box, with a roof above and partly open sidewalls. Six small latrines were constructed at convenient places about camp.

The food conservation projects undertaken by the company were a garden (in accordance with general orders) and a few hogs (voluntary) for the disposal of garbage. The hogs were kept in a pen 30 feet square in a corner of the mule corral, 200 yards west of the mess hall. From the start of the operation no trouble was experienced from fly breeding in the filth of discarded food cans, these being burned clean in the incinerator, pounded flat and stored for future use as a source of iron. Cleanliness was enforced about the company street and living quarters. The mule stable, housing 62 head, is believed by the writer to have been conducted in a sanitary manner. Some of the manure was spread on the garden plot and the rest used to improve the wearing qualities of the sandy woods roads. During the hot months the manure dried rapidly and was removed daily. Several inspections by the writer and

Mr. C. T. Dodds, a man with entomological training, failed to indicate the stable as a source of flies. The men's drinking water was supplied from two Lister bags, care being taken to chlorinate it whenever fresh water was put in. Personal cleanliness was the rule in camp and no cases of pediculosis in 1918 were reported, except two or three cases prior to the installation of the shower baths.

The men were careful about the disposal of excreta in the neighborhood of the camp. This was practically never deposited in the nearby woods, and during the period when open trench latrines were employed the sandy nature of the soil made it possible to push a large amount into the trenches with one turn of the foot and this matter was observed conscientiously by the men.

A small amount of fly breeding possibly occurred at the buckets where mess kits or dishes were washed, but was not observed in our inspections. Here the garbage receptacles sometimes were filled to overflowing, and water splashed or leaking from the wash buckets kept the sand moist.

The flies (principally *Musca domestica* L.) began to be numerous before the middle of June. By the last of the month they were very bad. It was found impossible with the limited amount of wire screening on hand to fly-proof the mess hall which had been built of green lumber. About the time the swarms of flies appeared the men were eating from dishes (instead of from mess kits) and helped themselves from cans placed on the tables before mess call. The flies simply swarmed over the food, and newspapers laid over the food dishes proved nearly useless as a protection. The non-commissioned officers' mess was served in a small room next to the kitchen where the flies were particularly bad. Before the men sat down the food was covered with flies, especially the meat, gravy and bread. It was necessary to eat with one hand and to use the other to keep the flies away. Darkening the room had no effect and conical fly traps, placed by Mr. Dodds at the two windows, caught comparatively few. Between meals the only light entering the room came through these traps but the flies preferred to remain inside.

Similar traps were placed over holes in the large latrine and great numbers of flies which probably matured in the pit below, were caught. It was out of the question to cover all the cracks left by the drying lumber or to construct the lids to prevent the passage of flies. Thousands of flies remained at rest on the rafters and roof boards, particularly in the evening, and an attempt was made in desperation to kill them with a blow torch. This treatment resulted in few deaths as the flies fell off with only their wings burned and crawled about, a worse nuisance than

before. Straw was burned in the pit at intervals but probably did little good as a temperature sufficient to sterilize the pit would have ignited the superstructure. A thick oil was supplied the camp for sanitary purposes but it was so viscous that the spray pump delivered a thin stream only and could not have been efficient as a means of preventing fly breeding in the pit. The small latrines received no better or worse attention.

Some of the men purchased cloth netting as a protection while sleeping, and a few strips of tanglefoot were used. The interiors of the cook's tents next to the kitchen were black with resting flies in the evening and the cooks at last were forced to abandon the location. The meat served was usually in a state of partial putrefaction; for weeks the men took little or none of it, much as they needed nourishing food at this time. Quarters of beef were sometimes dumped into the sand from the supply train and at times lay in the sun for half an hour, inviting the oviposition of blow-flies. The meat house was not fly tight, blue-bottle flies being at work there, and eventually a new house with walls and door of wire cloth was substituted. There was no refrigeration at the camp.

Beginning shortly after the middle of June and lasting throughout July the company was visited by an epidemic of dysentery. This disease attacked nearly the entire command and greatly weakened the men, some of whom were removed to the infirmary at Mimizan-les-Bains for treatment which consisted of a diet, principally of black coffee. Some days as many as thirty men reported at sick call in the morning.

Conditions about the kitchen steadily got worse. The drinking water from the driven well had a strong and disagreeable odor and the atmosphere about the building was such that the mess sergeant, who had his quarters there, was forced to move. Finally the kitchen floor was taken up and the cause of the condition found to be the overflow of the covered cesspool which had backed up over the whole area of the kitchen. The pipe of the driven well (about 25 feet deep) went down through this gray greasy liquid. A new well was put down about 20 feet from the old one and another sink hole was dug nearby. It is probable that the cesspool overflow served as a prolific source of flies and the strong odor probably accounts for the difficulty experienced in ridding the building of the pests.

General orders called attention to the prevalence of dysentery in the region and suggested various precautions to be taken against flies,

including the fly-proofing of mess halls. More or less thorough attention was paid the matter by the district health officer whose opinion that the flies bred in the dry sand was voiced in the writer's hearing. Mr. Dodds and the writer made a number of inspections of the camp and concluded that the main source of flies was the hog pen. The sand of the pen being impregnated with moist filth offered ideal breeding conditions and produced a constant and very large supply of flies. Thousands of newly-emerged individuals could be found drying their wings upon the moss outside the pen and the prevailing winds made the direction of the mess hall the course of least resistance. The district health officer was surprised to learn of the existence of the hog pen, but took no action. By showing puparia to the company commander and by loaning fly-control literature to the officers of the company the removal of the pen was accomplished—to another corner of the mule corral. The commander had the area of the old pen burned over, but examination showed this to be effective apparently to a depth of three inches only.

During the hot weeks visiting inspectors called occasionally at the camp, made hurried inspections, gave a little advice and usually considerable praise, and departed. Late in July the first case of Spanish influenza broke out in camp; on August 5th the disease was epidemic and on the 10th reached its climax, on which date 188 men of the 207 present strength of the 11th Company were sick. Only 3 or 4 of the company escaped the disease, and nine died, but of a detachment of 55 of the 45th Company, 20th Engineers, attached to the 11th Company, *not a man had the influenza.* This detachment worked and ate with the 11th Company and had tents close by, but they had been subjected to an insufficient diet for a period five months less than had the 11th Company.

During the epidemic of influenza the flies were almost intolerable. Men without mosquito netting had to sleep entirely covered with a blanket notwithstanding a high fever. The sides of the tents were rolled up to admit air and the sick men lay in their bunks and expectorated onto the sand, the sputum attracting the flies. A few of the men developed well-pronounced cases of pneumonia before their removal to the infirmary was accomplished, and the flies clustered upon their lips while sleeping uncovered.

The regiment of which the 11th Company was a small part was the largest in the Army, consisting of over 18,000 men separated in about 80 different camps throughout France and operating, when at maximum activity, 107 sawmills. From the data secured by the writer in con-

nection with the preparation of the history of this regiment it seems probable that the influenza epidemic at Lamanchs was the most severe in the entire command.

While there is no experimental evidence on the relationship of the house fly to the dysentery epidemic at Lamanchs, the general acceptance of the fact that flies are vectors of the disease is sufficient to warrant the flies being charged with its spread there. If we ignore the possibility that the flies had anything to do with disseminating the influenza and pneumonia organisms, we can still indict the insects with being a very important contributory cause of the epidemic of the latter diseases. The debilitating effect of dysentery, added to the weakening results of months of hard labor with insufficient food, accounts, in the writer's opinion, for the really startling fact that the 11th Company was 98% sick with influenza and pneumonia and the 45th Company Detachment showed a susceptibility of zero. Both had dysentery, but in the case of the 11th Company the effect of the disease was to lower the resisting power below the danger line.

No other interpretation of the situation has ever occurred to the writer. Immediately following the dysentery, the men were in a condition of subnormal vigor and their physical stamina collapsed in the presence of epidemic influenza. It may also be noted that the effect of the flies in rendering the food unappetizing, and therefore further restricting the inadequate diet, was considerable.

To whatever value may be placed on the lives as citizens of the nine men who died should be added the expense of training and transporting them overseas, the lost value of 9 more months of work in France, and $90,000 war risk insurance which they carried. The crippling of the operations at Lamanchs through dysentery and the entire cessation of work during the influenza are also largely chargeable against the house fly.

In view of the 14 years of house fly research and publicity which had elapsed since Reed, Vaughn and Shakespeare published their report on sanitary conditions in the training camps in the United States during the Spanish war, it is both disappointing to consider that those conditions were practically duplicated at Lamanchs and also difficult to write a dispassionate account of them. The consequences were different, however, and there was no typhoid, due undoubtedly to the innoculations. The published general and special orders on camp sanitation received at Lamanchs were from three principal sources:—headquarters of the Base Section, of the Services of Supply, and of the A. E. F.,—

and these were in accord with the best information. The trouble lay in their enforcement, and the fact that the subject of one official order was the epidemic nature of the dysentery and warning against flies indicates that the regulations were poorly enforced throughout the whole region of southwest France.

We must not assume too readily that as commissioned entomologists overseas we would have remedied all this. Early in 1918, when there were few flies, other things seemed more important. Fly control means work, and at that time the great need of the engineer troops in the rear was man power. The forest troops were working in shifts, 24 hours a day, racing with one another to meet the insistent demands for more lumber and ties, and it was no simple matter to get company commanders to give much attention to sanitary improvements.

But the writer feels that with commissioned entomologists assigned to groups of camps much that was unfortunate would not have developed. Energetic and insistent men could have accomplished a great deal with relatively little work, *done at the right time*, and such service would have paid dividends, both in money and in the increased comfort, efficiency and safety of the soldiers.

COLOR MARKING OF THE STRIPED CUCUMBER BEETLE (*DIABROTICA VITTATA* FAB.) AND PRELIMINARY EXPERIMENTS TO DETERMINE ITS FLIGHT

By John E. Dudley, Jr., and Ed. M. Searles
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Abstract

The wide spread depredations of the striped cucumber beetle, including both its feeding injuries and its role in the transmission of bacterial wilt and mosaic of the cucurbits, have been estimated to damage the crop to the extent of \$3,000,000 to \$5,000,000 a year in the United States. Many of the recognized control measures in the past have been of little or no value in killing the beetle, and their virtue as repellents has depended upon repeated applications to the growing crops because the beetles are constantly flying from field to field.

This project was undertaken to find the limits of the powers of flight of the beetle and its general habits as to flight.

After experiments with various dyes and coloring substances covering a period of three years, the most successful material for marking has been found to be six parts, by volume, of denatured alcohol (denatured with methyl alcohol), four parts of commercial, cut shellac, the mixture colored with a saturated solution of various anline dyes in alcohol. This material may be sprayed on the beetles with an atomizer. It dries quickly; adheres well to the body of the insect; retains its color indefinitely; and does not appear to interfere in any way with the normal functions of the insect.

During the summer of 1922 three lots of beetles totaling 25,786 individuals, were marked and released. Of these, 49 were recovered after an average interval of 4½ days. They flew an average distance of one-half mile, five flying over a mile each. This project is to be continued during the season of 1923.

Knowledge of the Insect's Habits of Flight Necessary for Control

The widespread depredations of the striped cucumber beetle and the need of adequate control measures are too well known to require mention here. The purely mechanical injury which it causes in its feeding is not the only offence laid at its door. The rôle of the beetle in the transmission of certain cucurbit diseases, as shown by recent investigators, proves it of even greater economic importance. The beetle not only disseminates cucurbit mosaic, but is also the chief if not the only carrier of the bacterial wilt of cucurbits. The damage caused by the beetle has been variously estimated at from $3,000,000 to $5,000,000 a year. Many control measures have been suggested and tested, some of which have proved effective in killing or repelling the beetles present, but none could be recommended as a complete control. The lack of efficiency has been due chiefly to the migratory habits of the beetles, for although they may be completely destroyed or driven away from a treated area, migration from surrounding untreated plantings will soon reestablish infestation. This project was undertaken, therefore, to define the limits of the powers of flight of the beetle; the maximum and average distance covered on the wing, and the frequency with which the beetle migrates from one planting to another.

Experiments in Marking

Experiments in marking beetles were begun in 1920, considerable time being devoted to finding a material and a method which would allow rapid and successful marking. The principal difficulty was in securing adhesion of the marking colors to the elytra. Among the substances tested were glue, colored chalks, aniline dyes, India inks, and shellac, and although tested singly and in various combinations, all proved unsuitable. Glue, dyed with an India ink, dried so slowly that beetles marked with it soon became entangled and incapable of flight. Colored chalks, which had been used successfully by other workers in marking bees and many Diptera, failed to adhere to the almost hairless bodies of the beetles. Aniline dyes or India inks, used without an adhesive, were almost indiscernable on drying. Commerical shellac had the same objectionable qualities as glue. The pigment finally employed was a precipitate resulting from thoroughly mixing two parts shellac and one part of various India inks. This precipitate was very adherent to the elytra of the beetle. It retained its color well and dried quickly but could not be suitably applied except by means of a small

camel's-hair brush. In order to make the normally very active beetles more easy to handle while being marked, a method of chilling by placing them in test tubes in ice water was employed. By this process the beetles were marked effectively. It was used also with complete success by N. F. Howard at Birmingham, Ala., in marking the Mexican bean beetle. This method, however, is very laborious, about 2,000 beetles per diem requiring two men's work. The principal problem during the season of 1922 was, therefore, to find some equally good marking agent which could be applied with much greater rapidity.

A coloring agent was finally produced by diluting shellac with alcohol, using alcohol-soluble aniline dyes as the coloring matter. The most satisfactory solution was one composed of six parts alcohol and four parts commercial shellac, colored with a saturated solution of the aniline dye in alcohol. This dried quickly, adhered well to the body of the beetle, retained its color indefinitely, and did not interfere in any way with the normal functions of the insect. An added advantage of the diluted shellac over former materials used was that it could be sprayed on the beetles with an atomizer. This material also provided a very effective marking agent for other insects, especially for bees. Bees marked with a solution of seven parts alcohol and three parts shellac dyed with aniline green, remained vividly colored seven days after they had been marked. A solution of eight parts alcohol and two parts shellac with aniline green as the coloring agent proved satisfactory for house flies and the potato aphis, the color being particularly conspicuous on the wings.

Present Technique of Marking and Recovery

The technique of marking beetles, liberating, and recovering them, has developed as the work progressed and no doubt will be still further perfected, but a most satisfactory method followed at present is here described: A large number of beetles, five to ten thousand or more, is collected from the field. The problem of collecting beetles is very simple after the first squash blossoms of the season appear, due to their decided preference for pollen. On these they congregate in large numbers and it is only necessary to gather the staminate blossoms to collect a great many beetles. The collected blossoms are placed in numbered ten-pound paper sacks. All the blossoms from a certain garden are placed in one sack and a note made as to the number of the sack and the name of the owner of the garden. The sacks are brought to the laboratory and opened, one at a time, in a field cage.

This method of collecting beetles in the field serves two purposes; to recover marked specimens and to obtain a supply for marking. As the beetles emerge from the sack, any marked ones can be easily distinguished and captured. When a marked beetle is found, the color with which is it marked determines the point at which it was released while the number of the sack from which it issued gives the location of its collection.

The unmarked beetles collected in the large field cage are transferred to a small cylindrical screen cage 3 inches by 7 inches and then taken, as needed, to test tubes which are graduated at the points to which 100, 200, 300, 400, and 500 beetles (by actual count) will come. In this manner, an accurate estimate may be made of the number of beetles to be marked without an actual count. A field cage is used in which to mark the beetles. It is fitted on each side with cloth containing head and arm holes and has a 20-mesh screen bottom. By employing this type of cage, it is possible for two operators to work at one time and mark more accurately and quickly. One operator shakes the beetles, about thirty at a time, from the test tube on the platform and then sweeps them from the platform to the floor of the cage after the other operator has sprayed them with the colored solution. The marking platform is a box of screen 2 inches by 4 inches by 6 inches set in the center of the cage. The beetles are marked on this platform and then swept immediately from it, in order to avoid giving them two coats of the spray material. If not over thirty beetles are shaken from the test tube to the platform at one time, it is possible for the person operating the atomizer to spray all of the beetles before they can escape. All marking is done out of doors in order that the shellac may dry more quickly and to prevent the operators from inhaling more of the spray than necessary. The marked beetles quickly crawl up the sides of the screen cage which facilitates the drying of the shellac. When all the beetles available at one time have been marked, they are taken in a cage to some predetermined spot, either in a cucurbit garden or some distance from one, and released. The cages are visited about 24 hours later and all beetles, which have not flown away, are counted and subtracted from the number marked. Therefore, the "number released" is the actual number which fly, or possibly crawl, away.

Experiments in Flight

During the summer of 1922, three lots of beetles, totaling 25,786 individuals, were marked and released. The results obtained are given in the following table.

TABLE I. GIVING RESULTS OF THE RELEASE AND RECOVERY OF THREE LOTS OF MARKED BEETLES. MADISON, WISCONSIN, 1922.

Experiment 1 Aniline Green Marked Beetles				Experiment 2 Aniline Blue Marked Beetles				Experiment 3 Gentian Violet Marked Beetles			
Number Released 3234				Number Released 18019				Number Released 4533			
Date Released July 12				Date Released July 20				Date Released July 31			
Place Released No. 12 (On map)				Place Released No. 35 (On map)				Place Released No. 14 (On map)			
Number Recovered	Place recovered (On map)	Interval (Days)	Distance Flown Miles	Number recovered	Place recovered (On map)	Interval (Days)	Distance Flown Miles	Number recovered	Place recovered (On map)	Interval (Days)	Distance Flown (Miles)
1	10	3	.48	1	13	1	.38	2	13	2	.18
1	3	5	.43	9	4	2	.30	1	20	2	.83
4	4	5	.42	2	3	2	.55	1	22	2	1.40
1	10	6	.48	3	15	4	.38	1	8	4	1.15
1	8	7	.91	2	3	6	.55	1	23	4	1.34
1	4	10	.32	3	3	7	.55	1	23	7	1.34
2	3	10	.43	2	4	7	.30	1	20	7	.83
2	10	12	.48	1	3	9	.55	2	11	8	.60
1	3	15	.43					1	4	14	.70
1	2	15	1.70								

Experiment No. 1 was conducted with beetles marked with aniline green. 3,234 beetles were released, of which 15 were recovered. The average interval was 8–1/3 days and the average distance from point of liberation was .52 miles. One beetle was recovered 1.7 miles from the point of liberation. This was the longest distance observed in any of the experiments.

Experiment No. 2 was conducted with beetles marked with aniline

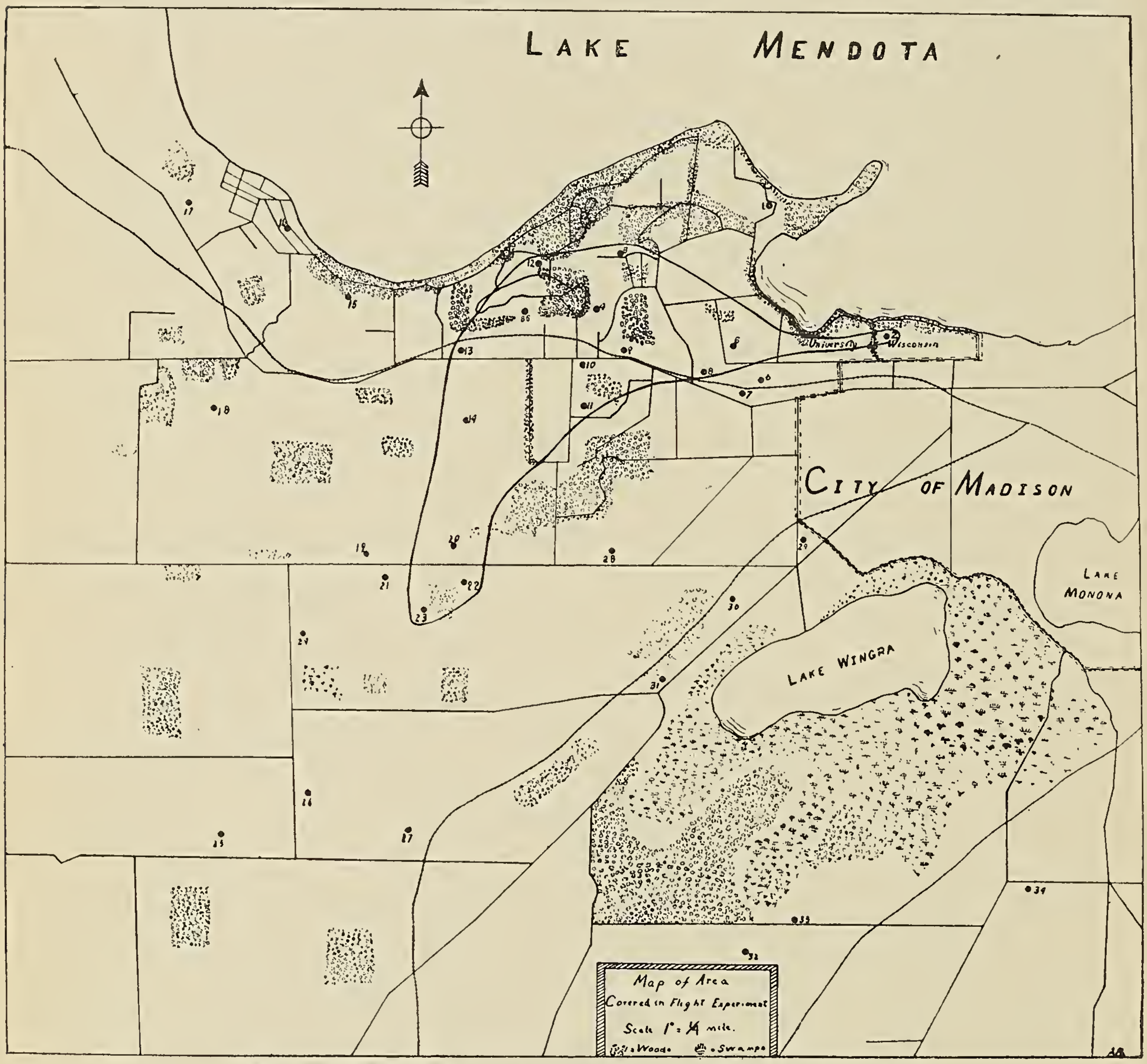

Fig. 3.—Map of area covered by flight experiments.

blue. 18,019 beetles were released, of which 23 were recovered. The average interval was 4 days and the average distance was .38 miles from point of liberation.

Experiment No. 3 was conducted with beetles marked with gentian violet. 4,533 beetles were released, of which 11 were recovered. The average interval was 5–1/2 days and the average distance from point of liberation was .83 miles. Four of these beetles flew over a mile each.

SOME EXPERIMENTS ON POISON BAITS FOR THE EUROPEAN EARWIG

By B. B. Fulton, *Oregon Agricultural Experiment Station*

Abstract

As a stomach poison for the European Earwig, sodium fluoride has an equal or greater amount of toxicity than arsenious oxide and acts more rapidly.

Wheat bran sweetened with molasses is sufficiently attractive to the earwigs for all practical purposes.

The addition of amyl acetate does not increase the attractiveness of the sweetened bran for earwigs.

Oat hulls are slightly more attractive than wheat bran. The adhesive property of the former makes it especially desirable for a bait to be applied to objects for poisoning half grown or adult earwigs, but not so good for scattering over the ground for young earwigs.

Glycerin does not lessen the attractiveness of a bait and increases the length of time during which the bait is effective.

The European Earwig (*Forficula auricularia* Linné) which has become an established pest in Rhode Island and in several cities of the Pacific northwest, has been found to be susceptible to poison bait control methods. Stale bread crumbs have been recommended for this purpose[1] but this material is difficult to prepare and scatter and is undesirable for large scale operations. Preliminary experiments showed that wheat bran was readily taken by earwigs when attractive materials are added, and since this is one of the best mediums from a practical standpoint, being easily mixed and scattered, it was adopted as a base for further experiments conducted in Portland, Oregon, during the summers of 1921 and 1922.

Tests of various poison bran mixtures made during the first season's work showed that earwigs are very resistant to arsenical poisons. Arsenious oxide or white arsenic in proportions two or three times as great as commonly used for grass hopper control required from two and a half to five days to cause death. Other tests were made using sodium fluoride as the poison and in every case death resulted much more rapidly than where an equal amount of arsenious oxide was used.

In all of these preliminary experiments a large element of error existed due to the fact that the insects used in the tests were collected from open piles of the poison bait and there was no way of telling how long they had been feeding. For this reason only very general conclusions could be drawn from the data.

For the experiments during the following season a small trap cage was devised which acted on the principle of a fly trap. The bait to be tested was placed in a small tight box with a screen front bent inwardly in the form of a wedge and having small holes at the innermost point of

[1]D. W. Jones. U. S Dept. Agriculture, Bulletin 566.

the screen. Earwigs attracted by the bait would readily enter and feed, after which they would seek a place to hide and find a darkened glass vial provided for that purpose. The earwigs were collected the following morning and kept in quart jars with cheese cloth covers and provided with plant food.

The following proportions of poison materials were used on the basis of four pounds of wheat bran:

Sodium fluoride (technical) 1, 2, 4 and 8 ounces.
Calcium fluoride (powdered fluorspar) 1, 2, 4 and 8 ounces.
Arsenious oxide (technical) 1, 2 and 4 ounces.
Sodium arsenate (technical) 2, 4 and 8 ounces.
All lots were moistened with a like mixture of molasses and water.

In Table I are recorded the total number of earwigs captured in each test and the number of dead found in the cages each morning following the evening during which the traps were baited. Since the baiting was done early in the evening, the counts on the first morning are approximately twelve hours after the poison was taken. On the second morning, a day and a half, and so on. Where a blank space occurs in the table after previously recorded dead, it means that no count was made on that day.

When these figures have been reduced to percentages and plotted out as a curve, a much better idea of the relative killing value of the different mixture can be obtained. This is shown in chart I. In order to avoid crowding, the series of sodium arsenate and the one lot of calcium fluoride in which marked killing resulted are plotted separately with the one curve of arsenious oxide dotted in for a basis of comparison. In the jars to which the earwigs were confined it was quite noticeable that those which had taken calcium fluoride were quite active, ate the leaves provided for food and were practically normal. In all other lots the insects were sluggish and did no feeding except a very little at first by those baited with the lower strengths of arsenious oxide.

It will be noticed that sodium fluoride at 2 ounces to four pounds of bran was approximately equal in speed of killing to arsenious oxide at 4 ounces, although in the former case one individual living over, caused the upper end of the curve to be extended four days. A comparison of the curves of sodium fluoride one ounce and arsenious oxide one ounce shows that at this dosage the former was much more effective. Calcium fluoride was the least poisonous of the materials used and in all proportions except eight ounces to four pounds, had little effect. The earwigs lived over ten days with no material decrease in number, while at twenty days a considerable proportion had died through over crowding and my neglect to feed and water them properly.

The curves for sodium arsenate show that while this substance acts rapidly it is not as poisonous or at least no more poisonous than arsenious oxide.

Sodium fluoride costs no more than arsenious oxide, at least when purchased in small quantities, and has certain advantages for use in a poison bait mixture. It is very soluble in water and does not need to be mixed with bran dry, as in the case of arsenious oxide. It can be dissolved in water with the attractive ingredients of the bait and any amount of bran desired for immediate use can be wet with this mixture and applied. It has marked antiseptic qualities so that mixtures containing it will keep indefinitely. It is also less toxic to humans than arsenious oxide. Sodium fluoride has been accidentally taken in doses of five, six and nine grams without causing death although severe sickness resulted.[2] In the case of arsenious oxide much less than a gram is said to cause death.

Preliminary tests of attractiveness of various materials were made during the first summer. Ground meat was one of the most eagerly devoured of all substances. The use of this material however, is impractical on account of cost and the difficulty of mixing with poison and scattering. Sweetened wheat bran seemed attractive enough for practical purposes but an effort was made to improve upon it if possible by the addition of other substances. One of the first substances tried was amyl acetate which has been found to be a valuable addition to poison bait for grasshoppers.[3] This was added to bran sweetened with molasses, as recommended for grasshoppers, enough to give a pronounced odor of banana, and eight small piles deposited at regular intervals along the top of a board fence, alternating with piles of the same material but without the amyl acetate. After a time the earwigs feeding at each pile were counted, with the following results:

With amyl acetate 6, 15, 8, 10, 10, 9, 10, 6.

Without amyl acetate 3, 16, 6, 6, 6, 8, 10, 25.

Totals: with amyl acetate, 74; without, 80.

In another similar test with eleven piles of each bait, the results were as follows:

With amyl acetate 10, 3, 2, 7, 5, 6, 10, 12, 6, 1, 3.

Without amyl acetate 9, 4, 6, 5, 6, 10, 10, 8, 6, 3, 6.

Totals: with amyl acetate, 65; without, 73.

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[2]Baldwin, H. B. The Toxic Action of Sodium Fluoride. Jour. Amer. Chem. Soc. 21, pp. 517–521, 1899.

[3]Parker, J. R., and Seamans, H. L. Jour. Ec. Ent. 14 pp. 138–141, 1921.

These results indicate that amyl acetate adds nothing to the attractiveness of poison bait for earwigs.

Another series of tests was made using wheat bran sweetened with molasses, and the same flavored with anise oil, meat extract and glycerin. These were placed out in sets of four piles each, one of each mixture. There were four sets containing all four mixtures and the number of earwigs feeding were counted at two different times during the night with the following totals:

Plain	18	Meat Extract	19
Glycerin	64	Anise oil	18

Four other sets containing only plain bran and molasses and the same flavored with meat extract gave the following totals.

Plain 17. Meat extract 29.

In these tests glycerin seemed to be the only material with very marked value, but further tests were needed to confirm this. At least it did not act as a repellant and its moisture retaining properties were quite valuable. On the following evening, the other mixtures were quite dry and hard while that containing glycerin was still moist enough to attract a good many earwigs.

During the second season's work further tests of mixtures containing molasses and glycerin were made. In the first series, water and molasses were mixed in proportions of two to one, and glycerin added to this to make 50%, 25%, and 12.5% solutions. Wheat bran was saturated with each mixture, and the 25% of glycerin mixture was also used with rice bran and oat hulls. These five mixtures were placed in small piles nearly a foot apart along a narrow board which was placed on the ground in a spot where earwigs were plentiful. Three counts of the earwigs feeding were made at about ten minute intervals. The insects were then driven off and the board was reversed and three other counts taken. The results were as follows, in the order of position on the board:

	1 Wheat bran Gly. 50% Mol. 16.6%	2 Wheat bran Gly. 25% Mol. 25%	3 Wheat Br. Gly. 12.5% Mol. 29.16	4 Rice bran Gly. 25% Mol. 25%	5 Oat hulls Gly. 25% Mol. 25%
3 counts....	22	22	21	42	70
Reversed order 3 counts....	100	84	86	64	102
Total......	122	106	107	106	172

Knowing that two piles at either end of the board would attract more

earwigs by virtue of position, the piles were then rearranged and another series of counts taken in the following order:

	3 Wheat bran Gly. 12.5%	2 Wheat bran Gly. 25%	1 Wheat bran Gly. 50%	5 Oat hulls Gly. 25%	4 Rice bran Gly. 25%
1st position.	32	27	17	30	50
Reversed...	53	42	44	60	64
Total......	85	69	61	90	114

From these results it would appear that the three mixtures of glycerin and molasses are approximately equal in attractiveness, while the mixtures containing rice, bran and oat hulls were slightly more attractive, the latter giving the highest total count.

Rice bran and oat hulls are not of such a nature that they can be scattered easily and this mechanical objection would exclude them for use on the ground, but as a bait to be applied to objects, for late summer work after the earwigs are old enough to climb about, they would be superior to wheat bran.

In another series of tests the attractiveness of glycerin alone was compared to molasses alone, and to bran wet with water only. Five piles of bran were placed on a board as follows and counts made in two locations:

	Water	Mol. 25%	Mol. 50%	Gly. 50%	Water
Totals.....	60	81	104	47	56

From these figures it is evident that glycerin alone adds little if anything to the attractiveness of the mixture. The advantage of position would probably account for the fact that more earwigs visited the bran piles wet with water alone.

These materials were left in the last location until the following night when they were examined. The bran which had been wet with water alone was thoroughly dry, those with molasses were very slightly moist, while that containing glycerin was distinctly moist. Two counts of earwigs at different hours gave the following:

Water	Molasses 25%	Molasses 50%	Glycerin 50%	Water
4	13	37	51	1

At any one time more earwigs were feeding at the glycerin pile than at any time on the previous evening, due no doubt to the lessened attractiveness of the other mixtures.

Another comparison was made using mixtures containing molasses and the poison ingredient, sodium fluoride, with glycerin and without. The first lot of bran was wet with a mixture containing equal volumes of sodium fluoride solution (1 ounce in 4 ounces of water), glycerin and molasses. In the second lot the glycerin was replaced with water leaving identical amounts of poison and molasses. This experiment was primarily planned to see if glycerin affected the poisonous properties; but the two lots were exposed to get additional evidence on the attractiveness. The results on the first night were: first mixture, 38; second mixture, 37. On the second night: first mixture, 16; second mixture, 3.

POISON USED WITH EACH 4 lbs. BRAN	TOTAL EARWIGS IN LOT	TOTAL DEAD EACH MORNING AFTER EVENING OF POISONING										
		1	2	3	4	5	6	7	8	9	10	20
NaF 1 oz.	85		1	23	66	77		83	83	83	83	
NaF 2 oz.	43	1	5	28	36	42	42	42	42	43		
NaF 4 oz.	24		7	19	23	24						
NaF 8 oz.	104	14	56	101	104							
CaF_2 1 oz.	14				1	1	1	1	1	1	1	7
CaF_2 2 oz.	120							2	2	2	2	85
CaF_2 4 oz.	59							1	1	1	1	43
CaF_2 8 oz.	81		8	41	56	69	73	74	75	75	75	77
As_2O_3 1 oz.	41	1	1	1	3	4		26	37		40	
As_2O_3 2 oz.	41		1	9	24		38	41				
As_2O_3 4 oz.	74		4	34	66		74					
Na_3AsO_4 2 oz.	9			4			6	9				
Na_3AsO_4 4 oz.	33	2	8	25	28		31	32	33			
Na_3AsO_4 8 oz.	111	7	16	65	98		111					

Table I. Showing toxicity of various amounts of sodium fluoride, calcium fluoride, arsenious oxide, and sodium arsenate for the European earwig.

This, and the previous experiment both show that glycerin has considerable value as an ingredient to extend the attractiveness of a poison bait over a longer period of time.

The killing effect of the two above mixtures was approximately equal. When mixed with bran they gave a poison bait containing about 8 ounces of poison to 4 pounds of bran, equal to the strongest mixture shown in Table I. The mixture containing glycerin gave 45 dead and 1 alive on the second morning, while the mixture without glycerin gave

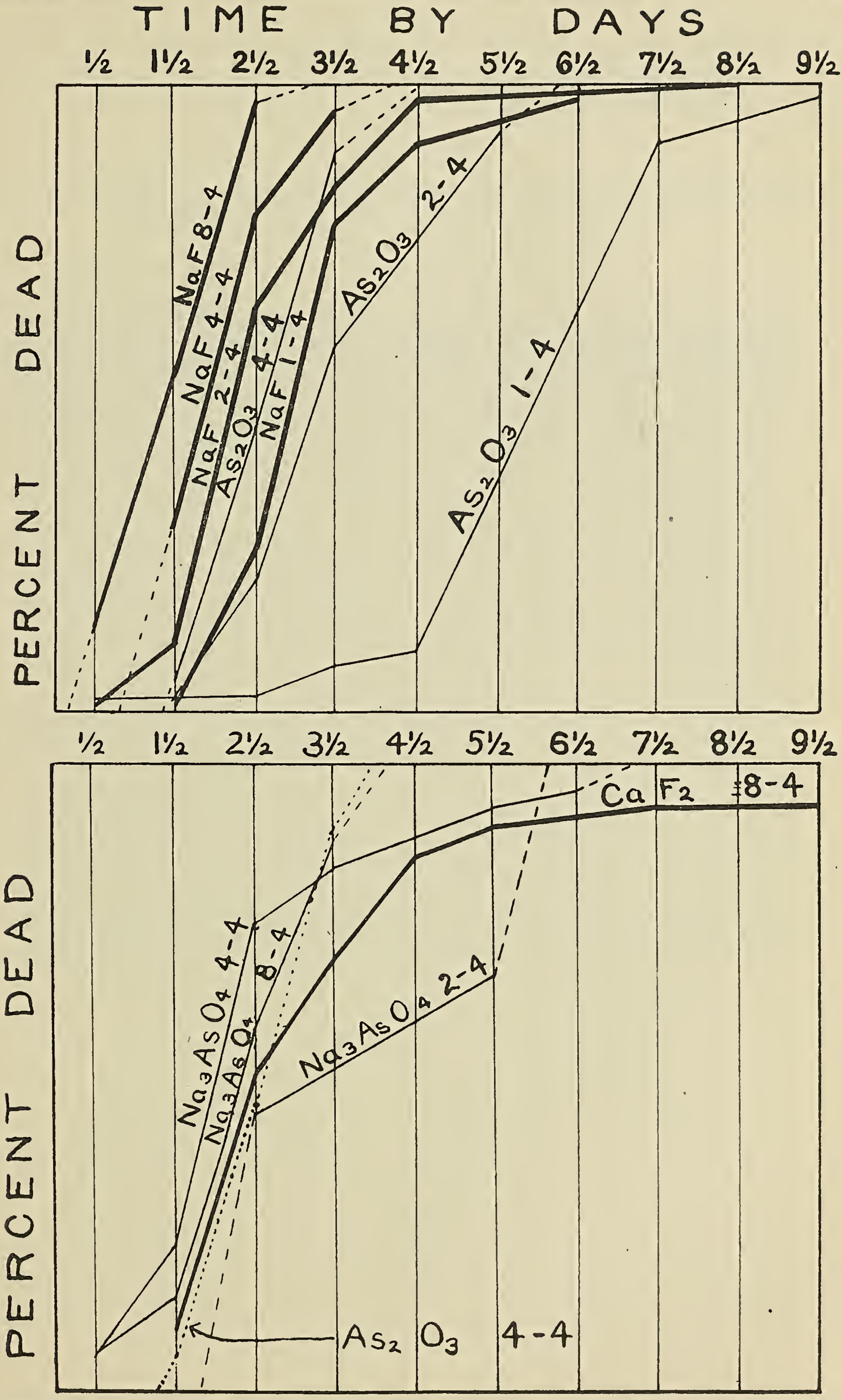

Chart I. Curves showing toxicity of sodium fluoride, arsenious oxide, sodium arsenate and calcium fluoride, for European earwig.

45 dead and 4 alive. On the third morning all were dead. From this we can judge that the glycerin does not interfere with the poisonous properties of sodium fluoride.

EMERGENCE RECORDS OF THE PEACH TREE BORER, *AEGERIA EXITIOSA* (SAY), IN PENNSYLVANIA

By Eugene M. Craighead, *Bureau of Plant Industry, Harrisburg, Pa.*

Successful control of the peach tree borer by the use of Paradichlorobenzene (commonly called PDB) is dependent on an accurate knowledge of its habits and especially on the determination of methods for securing the maximum kill. In order to secure accurate data on adult emergence, experiments were conducted for two years in Franklin County, Pa., at the Chambersburg Laboratory of this Bureau under the supervision of Prof. J. G. Sanders, Director.

In 1921 from May 15th to August 10th, nearly 700 cocoons were collected, of which number about 500 contained larvae. From the 500 pupae, 174 males and 184 females emerged, making a total of 358 adults. About 4% of the pupae were parasitized. In May, 1922, wire cages

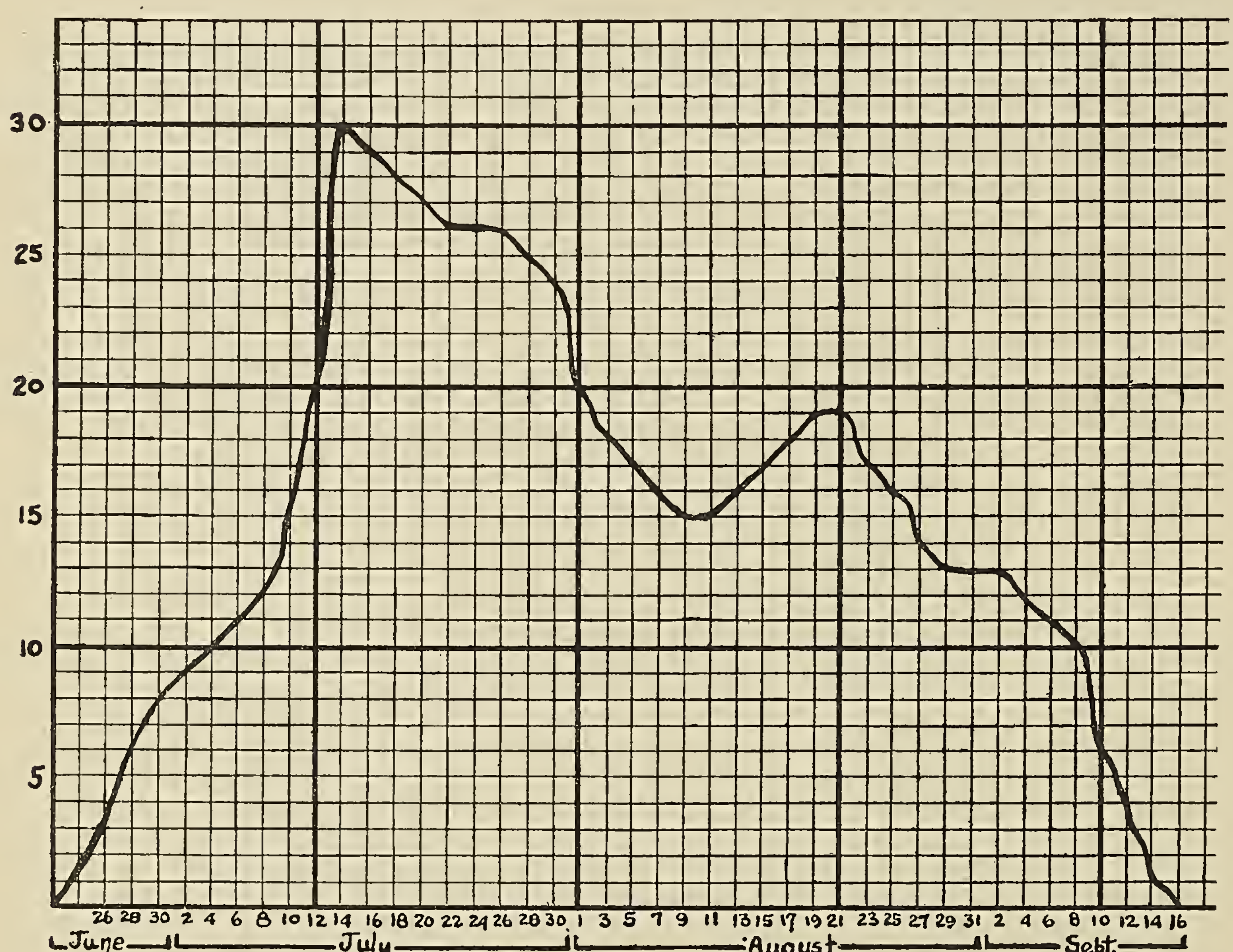

Fig. 4—Emergence of peach tree borer adults for 1922.

Plate 5

Base of tree caged to obtain emergence records of peach tree borers

were placed around 52 trees and records were made every two or three days from June 1st to October 5th during the emergence season. (Pl.5) From the 52 trees a total of 657 adults were recorded, the first adult emerging June 26th, while the first record of emergence in 1921 was June 16th. However, that year the season was from two to three weeks early.

Cages for obtaining emergence records were made of fine fly wire thirty-six to forty inches wide. (Pl.5). They were made by cutting along the circumferences of two radii: One, that of the tree fourteen inches from ground and the other that of tree at the ground line plus six inches. (A little practice makes measurements unnecessary.) The edges were fastened by means of brass paper clips. The bottom was buried two or three inches and the top about the tree made tight by packing cotton between the cage and the tree.

Adults were killed by stabbing them with a long hat pin, a method which saved hours of labor in opening up cages every time adults emerged. No records were made unless adults were alive in the cage at the time of examination. Ants and ground beetles soon devoured the dead bodies. The total number emerging, as before given, was 657, making an average of 12.6 per tree.

Control: Many parasites of the species, *Microbracon sanninoides* Gahan, were reared and identified by Mr. S. A. Rohwer. Two more parasites have been turned over to Mr. Rohwer and one of these is reported to be a new species; the other is as yet undetermined.

Treatment with PDB: With Sept. 15th as the date of the last emergence of the adults in vicinity of Chambersburg, Pa., it was deemed advisable not to start treatment with paradichlorobenzene before this time. Trees three years of age have been treated without injury, using one-half ounce per tree, for a period of two weeks and then promptly removing the mounds. Results of control with trees of this age and older gave a control ranging from 90 to 99 percent.

NOTES ON THE INSECT PESTS OF UTAH[1]

By Ira M. Hawley, *Logan, Utah*

Many parts of Utah, because of the mountain ranges and the dry and uncultivated lands that separate the tilled portions of the state, are protected from the gradual spread of injurious insects. For this reason many pests of long standing in most parts of the country are still absent or but recently introduced into the state. The Colorado potato beetle

[1]Contribution from the Entomological Department, Utah Agricultural College.

may be mentioned as an example of this. Tho it has spread from its native home on the upper Missouri River to most parts of the United States, it has not reached the state of Utah, and potatoes may be grown as a rule without treatment for insect pests.

Many common fruit pests, such as the apple maggot, bud moth, red bugs, case bearers, pear psylla, and pear midge, are not found in Utah. The fruit-tree leaf-roller has been in the state at least fifteen years but is not as yet general in its distribution. The same may be said of the canker-worm and pear-leaf blister mite which are of more recent importation. The San Jose scale, tho of common occurrence in some localities, has never been found in Cache County, an isolated valley in the northern part of the state. It may be seen, therefore, that spraying practice is often much simplified. In spraying apples, the "pink" spray is always omitted and in some places a dormant spray is not considered necessary.

In a state where the raising of sugar-beets is as extensive as it is in Utah, the insect pests of this crop, as would be expected, are abundant and must always be considered important. The sugar-beet web-worms (*Loxostege sticticalis* L.) were so numerous in 1921 that unsprayed beets were often totally destroyed. Four hundred caterpillars were present on some plants, and as they approached maturity they began migrating by the thousands. This abundance of the worms gave an excellent opportunity for the increase of parasites. From a lot of eleven hundred larvae in winter cocoons that were collected in the fields during September, 176 moths of the web-worms and 396 parasites were reared. It is believed that the presence of these parasites in such large numbers is largely responsible for the small number of caterpillars present in 1922, for in spite of favorable hibernating conditions very little damage occurred during the past summer.

The sugar-beet root-louse (*Pemphigus betae* Doane) was very common in 1921 as was also the beet-leaf miner (*Pegomyia hyoscyami* Panzer). The first brood of this last mentioned pest has been abundant enough to destroy many of the early leaves during the past two years, but the second brood has been so small that there has been no loss later in the season. The sugar-beet root-maggot (*Tetanops aldrichi* Hendel), which has been described in a previous number of THE JOURNAL OF ECONOMIC ENTOMOLOGY[2] and which was responsible for considerable loss in 1921, caused almost no damage in 1922, due apparently to the hot and dry condition of the soil when the eggs of the insect were deposited in it.

[2]Jour. Econ. Entom., v. 15, p. 388.

There were so many of these eggs that shriveled that only a very small percentage hatched. The sugar-beet crown-borer (*Hulstea undulatella* Clemens) was so abundant that 30 to 50 per cent of the plants were destroyed in some fields. This insect was described by Titus[3] in 1905 and its presence in Utah has been known for at least eight years. The larva works on the crown of the beets and either cuts off the top or injures it so that it does not develop. When one tries to pull up a badly infested plant, it breaks off at the crown where the caterpillar in its silken cocoon may be found feeding.

The beet leaf-hopper (*Eutettix tenellus* Baker) has been more injurious during the past summer than for several years. It was especially bad in Sevier and Millard Counties, but was found locally in other beet-growing sections. This may be a forerunner of a still more severe infestation next year.

The alfalfa weevil was not an important pest during the summer of 1922. The writer does not know of a case where it was considered sufficiently serious for control measures to be applied. The alfalfa caterpillar (*Eurymus eurytheme* Boisd.) as a pest of alfalfa was of negligible importance, but in Weber County it caused considerable loss by feeding on the skins of watermelons. Tho this did not greatly impair the edibility of the melon, it did seriously reduce its market value. The clover-seed chalcid (*Bruchophagus funebris* Howard) has been very destructive to alfalfa that was being grown for seed, especially in the Uintah Basin.

The outstanding features of the year have been a later-summer infestation of corn ear-worm in both field corn and sweet corn that in some cases affected 100 per cent of the ears and the destruction of newly planted apple orchards in Utah County by a tree hopper (*Stictocephala festina* Say), especially when the orchard was set out in or near an alfalfa field or patch of sweet clover. There has also been a marked increase in the number of grasshoppers in many parts of the state, and since in many places poisoning campaigns have not been undertaken on a general scale, considerable loss has been sustained. The so-called "black" or "Mormon" cricket (*Anabrus simplex* Hald.) has also been on the increase during the past two years and is creating much interest in view of the immense losses that it caused to the early settlers of the state. It would not be surprising if the insect were still more abundant next year.

[3]U. S. D. A. Bur. Ent. Bul. 54. (n. s.)

NOTES ON THE LENGTH OF TIME AEDES CALOPUS (STEGOMYIA) LARVAE SHOULD BE EXPOSED TO A FILM OF KEROSENE

By M. E. Connor, M.D. and W. M. Monroe, M.D.
International Health Board

Abstract

A ten-minute exposure to a film of kerosene is sufficient to cause the death of all but a very small percentage of *Aedes calopus* larvae, and for this reason washerwomen may after ten minutes skim off the film of kerosene from their water containers and use any portion of the water underneath.

It would also seem that the petroleum acts not only to exclude the larvae's supply of oxygen but also as a toxin, and in this capacity is responsible for most of the larval death rate, as its toxic action is more rapid than its mechanical effect.

The question as to the length of time that the *Aedes calopus* larvae live after the oxygen of the air has been denied them came up for study in the field work of the staff engaged in the control of yellow fever in Tampico, Mexico.

Throughout the gulf coast region of Mexico the tap and well water are so heavily charged with calcium salts that the washerwomen find it necessary to mix wood ashes with the raw water in order to counteract its hard quality. The softened water, which is called *lejia*, is alkaline in reaction and appears to be especially attractive to the *Aedes calopus*. Receptacles in which *lejia* is stored can be made proof against mosquitoes only by covering the surface of the water with refined petroleum. These containers cannot, like the tanks, be supplied with perfectly fitting covers, nor can they be stocked with fish like the barrels containing fresh water, for fish will not live in *lejia*. Moreover, the container cannot be emptied and left inverted, since *lejia* is important as a means of livlihood to a large number of people. It was the practice of our inspectors, therefore, to place a good film of oil on the surface of the *lejia* in which breeding was known to occur, and this measure appeared to be successful in killing in a reasonable time the greater number of larvae in the containers.

Frequently, however, in the course of re-inspection of mosquito control work, a single larva would be found in many of the *lejia* containers that had been treated to a coating of kerosene. The suspicion arose that either the inspectors had not properly oiled the containers or that the larvae were developing resistance to the oil. When one district inspector reported that he had detected a woman skimming from a *lejia* container a film of oil placed there only a few minutes before, the mystery of the single larva was partly explained, and there was opened up the interesting question as to the minimum time that a good film of oil must remain on *lejia* to be effective.

The time required to kill larvae through depriving them of oxygen

from the air could easily be determined. This was done in our laboratory by filling a bottle completely full of water containing larvae, then placing the thumb over the top to prevent the admission of air, and inverting the bottle in a larger jar of water much as is done in fashioning a home-made barometer. The larvae, thus prevented from obtaining any oxygen whatsoever except what they might get from the water itself, died in from three and one-half to thirty-six hours. A good film of kerosene, however, had been found to kill all but a very small per cent of larvae in from 60 to 100 minutes, though an occasional small larva was known to have lived under an oil film for as long as three days.

Recently many experimenters have come to believe that kerosene acts upon larvae not only mechanically by excluding the supply of free oxygen, but also as a poison showing a selective action on the epithelium lining the inside of the air siphon. If this is true, only a short exposure of the larvae to the coating of oil should be necessary for their elimination and the inspectors may safely permit the washerwomen to remove the oil from *lejia* in much less time than one hour.

In order to determine the length of time larvae survive under an oil film, a series of four experiments was conducted. In the first of these, six wide-mouthed bottles were set up in the laboratory and nearly filled with water. Twenty larvae were placed in each bottle, and a thick layer of kerosene was applied to the surface of the water. After periods varying from one-fourth to one and one-half hours, the kerosene was decanted and completely removed by adding water until the bottle had overflowed for some minutes. The kerosene in two of the bottles was allowed to remain, thus serving as a check to determine the length of time required for the film of kerosene to kill the larvae. Results of this experiment are shown in Table 1.

It was seen that larvae could be destroyed by a much shorter exposure to the action of the oil than was employed in the foregoing experiment, for in all the bottles from which the oil was removed the larvae died nearly as soon as those in the check bottles. Only one exception occurred: in bottle 5, one larva recovered entirely and did not seem to be injured at all by an hour's exposure to the oil. In view of the fact that the other fifty-nine larvae were destroyed by the same or shorter contact with the oil, it may be assumed that either this larva had remained at the bottom of the bottle, subsisting on stored up oxygen or extracting the needed oxygen from the water by means of its anal gills, or else had for some reason remained refractory to the action of the poison. It would seem that the presence of a single larve in *lejia* or in

other deposits that have been treated with oil may be similarly explained. We have known of one case in which there were even second-stage Stegomyia larvae in a tambour of water on which a film of oil had been placed by an agent twenty-four hours before.

In a second experiment five bottles were set up and supplied with water, larvae, and kerosene, which was removed after periods of five, ten, fifteen, or thirty minutes. In the bottles from which the oil was removed after five minutes a large proportion of larvae survived, but in all the other bottles the larvae were killed. It may be assumed therefore that the time of exposure necessary to kill all but a very small number of larvae lies between five and ten minutes. (See Table 2.)

In a third test the larvae were exposed to the oil for one, two, three, and four minutes respectively, but it was found that too high a percentage of larvae survived these shorter contacts. (See Table 3.)

The larvae destroyed in these experiments were killed either by the toxic action of petroleum or by the exclusion of their supply of oxygen. In the latter case death may have been due to long exposure to the kerosene or, where the larvae were subjected for but a short time to the action of the kerosene, death may have resulted from the occlusion of the breathing syphon with a globule of oil. It is reasonable to suppose, however, that the larvae could free themselves of an impeding globule of kerosene by the use of their mouth brushes. Certainly the exclusion of their supply of oxygen for five or ten minutes would not kill them, for it has been shown that *Aedes calopus* larvae will live for from three and one-half to thirty-six hours when deprived of oxygen by mechanical means only. The death, then, of those larvae exposed but for a few minutes to the film of kerosene can be accounted for only on the supposition that the kerosene acted as a selective toxin.

Not all oils show this toxic property, as was discovered by a further experiment. In this test we used large bottles nearly full of water, adding only ten larvae to each bottle to avoid the complication of suffocation through overcrowding. In the first three bottles we placed a thick layer of gasoline; in the next three, different grades of kerosene; in the next three salad oil, and from the last three we excluded air by mechanical means. At the end of two hours all the larvae were dead under the gasoline and kerosene, but under the salad oil twenty-four were still living, while twenty-eight were living in the bottles from which the air had been excluded by mechanical measures. At the end of seven hours there were eight larvae living under the salad oil and nine

in the bottles from which air had been excluded mechanically. Salad oil must, therefore, lack the toxic properties of petroleum.

There is a vast difference in the behavior of larvae whose air supply has been excluded by mechanical means and that of the larvae which have been deprived of air by a film of kerosene. The former seek to retain their position at the surface of the water, thrusting their syphons again and again against the cover glass and continuing a rapid movement up and down until they die from utter exhaustion. Under a film of kerosene, on the other hand, the larvae will either almost immediately leave the surface, dropping down to the bottom of the container where they remain prone for long periods of inactivity followed by spasmodic movements of their posterior abdominal segments, or else they will float on the surface of the water wriggling little if at all.

TABLE I.—LENGTH OF LIFE OF AEDES CALOPUS LARVAE IN WATER COVERED WITH PETROLEUM FILM. PERIODS OF EXPOSURE ¼ TO 1½ HOURS. (FIGURES INDICATE THE NUMBER OF SURVIVING LARVAE)

Time	Pet. Not Removed		Petroleum Removed After			
	Bottle 1	Bottle 2	¼ hour Bottle 3	½ hour Bottle 4	1 hour Bottle 5	1½ hour Bottle 6
(9.40) A. M.	20	20	20	20	20	20
9.45	15	14	15	14	13	10
9.50	12	11	13	12	11	8
10.00	7	8	13	10	7	5
10.10	4	5	5	6	3	5
10.25	3	3	4	3	3	2
10.40	1	2	3	3	2	2
10.55		2	2	3	1	1
11.35		1		1	1	
12.15 P. M.		1		1	1	
2.00 P. M.					1	

TABLE II.—LENGTH OF LIFE OF AEDES CALOPUS LARVAE IN WATER COVERED WITH PETROLEUM FILM. PERIODS OF EXPOSURE 5 TO 30 MINUTES

Time	Petroleum Removed After				
	5 min. Bottle 1	10 min. Bottle 2	15 min. Bottle 3	20 min. Bottle 4	30 min. Bottle 5
10.25 A. M.	20	20	20	20	20
11.00	18	12	11	9	13
11.30	18	8	9	7	11
12.00	18	3	5	2	7
12.30 P. M.	18		3		3
1.00	18		2		3
1.30	17		1		2
2.00	12		1		1
2.30	12		1		1
3.00	8		1		1
4.00 P. M.	7				1
7.30 A. M.	5				

TABLE III.—LENGTH OF LIFE OF AEDES CALOPUS LARVAE IN WATER COVERED WITH PETROLEUM. PERIODS OF EXPOSURE 1 TO 5 MINUTES

Time	Petroleum Removed After				
	1 min. Bottle 1	2 min. Bottle 2	3 min. Bottle 3	4 min. Bottle 4	5 min. Bottle 5
10.00 A. M.	20	20	20	20	20
10.25	20	16	13	10	12
11.00	18	10	8	6	8
11.30	16	8	6	4	4
12.00	11	5	5	3	2
12.30 P. M.	11	5	4	3	2
1.00	11	4	3	3	2
1.30	10	3	1	3	2
2.00	10	3	1	3	1
3.00	7	3	1	3	1
4.00	7	3	1	3	1
5.00	7	3	1	3	1
8.00 A. M.	7	3	1	3	1

TABLE 4.—LENGTH OF LIFE OF AEDES CALOPUS LARVAE IN WATER FROM WHICH OXYGEN WAS EXCLUDED BY VARIOUS METHODS

Time	Gasoline Film			Kerosene Film			Salad Oil Film			Mechanical Measures*		
	Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7	Bottle 8	Bottle 9	Bottle 10	Bottle 11	Bottle 12
9.00 A. M.	10	10	10	10	10	10	10	10	10	10	10	10
9.30	5	7	6	4	6	5	10	10	10	10	10	10
10.00	3	4	2	2	2	3	10	10	10	10	10	10
10.30	1	2	2	1	1	2	9	10	8	10	10	10
11.00	—	—	—	—	—	—	8	9	7	10	10	8
11.30							8	9	7	9	8	5
12.00							8	9	6	5	6	
12.30 P. M.							8	9	6	5	6	
1.00							8	9	6	5	6	
1.30							8	9	6	5	5	
2.00							8	6	6	5	4	
2.30							8	5	5	5	4	
3.00							6	5	5	5	4	
4.00							6	1	1	5	4	
5.00							1	–	1	5	4	
6.00							—	—	1	5	4	
8.00							—	—	—	3	3	
7.30 A. M.										1	2	
9.00										1	2	
12.00										1	2	

*Oxygen excluded by inverting bottle in larger container.

PARASITISM OF THE EUROPEAN PINE SAWFLY, *DIPRION (LOPHYRUS) SIMILE* HARTIG, HYMENOPTERA, TENTHREDINIDAE, IN PENNSYLVANIA[1]

By E. A. Hartley

N. Y. State College of Forestry, Syracuse, N. Y.

Heavy parasitism of the European Pine Sawfly in America has apparently rendered this potentially injurious immigrant of little importance as a pest of our pines. Evidence of a prompt attack of this imported species by our native parasites was first reported by Dr. Britton[2] shortly after the discovery of the sawfly in America, when he reared the following native species: *Pachyneuron* (*Dibrachys*) *nigrocyaneus* Nort. parasitizing 31%, and one specimen each of *Hemiteles utilis*[5] Nort., an Ichneumonid, a species of *Cerambycobius*, and a Tachina fly, *Exorista petiolata* Coq. In 1917 Dr. Britton[3] after a large collection of over-winter cocoons, reported 37% parasitism involving the following parasites: *Pachyneuron* (*Dibrachys*) *nigrocyaneus* Nort., *Monodontomerus dentipes* Boheman *Dibrachoides verditer* Nort., (*Pteromalus*), *Delomerista* n. sp., *Cerambycobius* sp. (probably new), *Eurytoma* sp., *Hemiteles utilis* Nort. and the Tachina, *Exorista petiolata* coq. Only the first three were in effective numbers. All of these parasites are natives except *Monodontomerus dentipes* which is a European species previously found in the United States. In the spring of 1917, Weiss[4] reported a parasitism of 90% by *Mondontomerus dentipes* for the European Pine Sawfly in New Jersey.

Diprion simile was first noticed in the Philadelphia District in 1918 when only a few larvae were collected on a small row of *Pinus cembra*. Scattered larvae were noticed on *Pinus strobus* and *P. cembra* in several parts of a large nursery during the three years following, but nowhere had they increased to destructive numbers, except perhaps, in about a half acre block of *Pinus cembra* in the summer of 1921 where the infestation was about evenly distributed thruout the block and heavy enough to cause noticeable defoliation. Larvae were conspicuous on practically every tree.

In early June of the following season (1922) the block of pines was again examined and a marked decrease in the infestation was at once noticed; for in spite of the presence of many over-winter cocoons on

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[1]Contribution from the Bureau of Plant Industry, Harrisburg, Pa., and the New York State College of Forestry, Syracuse, N. Y.

[2]Fifteenth Connecticut Report. [3]Seventeenth Connecticut Report.

[4]Jour. Econ. Ent., Vol. X, No. 1, 1917.

[5]Now H. Tenellus says; Cushman & Gahan, Proc. Ent. Soc. Wash., 23:163, Oct. 1921.

the twigs, only a few larvae were found to a tree. A number of these over-winter cocoons were collected and a count disclosed 238 out of 321 containing exit holes of parasites. At the same time several adult parasites were noticed ovipositing in newly spun cocoons and other adults of the same species were swept from the foliage. These were later determined by Mr. Gahan of the U. S. National Museum as *Monodontomerus dentipes* Boheman. Ninety-four freshly spun cocoons were taken June 16th which yielded 39 adult sawflies by July 2nd, and 118 parasites from 15 cocoons. By July 14th, 59 more parasites had emerged from 12 cocoons. All of these parasites were *Monodontomerus dentipes* except 6 specimens of *Eurytoma* sp. and 2 *Cryptus lophyri* Nort., determined by Mr. Gahan. The 28 remaining cocoons were kept in storage at room temperature (70 degrees F.) until Jan. 5th 1923, when they were all opened. Four of the cocoons contained adults, mostly dead, of *Monodontomerus dentipes*, 16 others carried from 1 to 15 living parasite larvae, and 8 bore dead and shriveled remains of sawflies.

From the above figures, this lot of 94 cocoons of the first spring brood of *Diprion simile* gave a parasitism of 53%, almost entirely *Monodontomerus dentipes*.

Another lot of 123 cocoons collected July 17, 1922, gave one *Diprion simile* and a number of *Monodontomerus dentipes* by August 5th. No more sawflies or parasites emerged that season. The following January 5, 1923, the remaining cocoons were opened and 86% were found to contain parasites in some stage, averaging 9 parasites to a cocoon. Twelve cocoons contained live pupae and three were full of dead adults of *M. dentipes*. The great majority, however, bore from one to 20 larvae all very much alike. Two of the cocoons yielded the puparium of a fly, probably a Tachina. In one the fly had emerged inside the cocoon, but was apparently unable to reach the outside thru the tough walls of the cocoon. This condition has been previously noted by Dr. Britton.[5]

No evidence of secondary parasitism was noted in these dissections, unless, perhaps, in the presence of a few dead larvae, the cause of which was impossible to ascertain.

Several cocoons contained the withered remains of the sawfly covered with a fungus mycelium, often with living larvae of the parasites, showing their ability to live with the fungus.

In one or two cases, adult *D. simile* were found in their cocoons with

[5]Seventeenth Connecticut Report.

the living larvae of parasites, showing successful attack by the parasites in the later stages of the host development. This is not surprising when it is recalled that *M. dentipes* was observed in the field ovipositing in the cocoons of *D. simile* on the pine twigs.

Monodontomerus dentipes Boh. has been recorded from Holland by Ritzema[6] as a parasite from the cocoons of *Diprion pini*, a species often confused with *D. simile* in Europe, and it is highly probable that it was introduced into the United States in cocoons of *D. simile* on imported pines. It also occurs in Europe as a parasite of Lepidoptera, *Dendrolimus* (*Bombyx*) *pini* in Austria, and from the cocoons of *Zygaena occitanica* Vill. in France. A similar species, *Monodontomerus aerus* Walk. was early introduced against the gipsy and brown-tail moths in New England where it has become a widespread pupal parasite. Unfortunately it is also a secondary about as much as it is a primary, so its usefulness is in question. Whether *M. dentipes* will attack our native Lepidoptera as it does in Europe, or become a dangerous secondary in Lepidoptera here as in case of its near relative, *M. aereus*, remains to be seen. In spite of these evident possibilities, the above data show for the present at least, that it is one of the most effective natural checks to the European Pine Sawfly in New Jersey and Pennsylvania.

The other two species reared, *Eurytoma* sp. and *Cryptus lophyri* Nort. were not found in sufficient numbers to be considered of much importance in suppressing the European Pine Sawfly in America. However, it may be interesting to note that this is the first record of *Cryptus lophyri* Nort. in *Diprion simile* in the United States.

THE EFFECT OF CS_2 ON THE GERMINATION OF SEEDS

By C. J. Willard, *Farm Crops Department, Ohio State University*

Abstract

1. It would seem that in practice no aeration of storage places is necessary after fumigation with CS_2 whatever dose may be used, unless they are airtight. Bins and similar storage places for seeds almost never are airtight and before any of the longer periods reached by these experiments had elapsed the CS_2 would have diffused out of the bin.
2. It required very large doses of bisulphide for a considerable period of time to have any marked effect on the germination of the seeds used in this experiment. The injury slowly becomes greater as the time increases and as the dose increases, but is not directly proportional to either.
3. Seeds vary tremendously in their resistance to CS_2 injury.
4. Different varieties of the same species are very differently affected, perhaps due to the pigment in the seedcoat. (Note garden beans and cowpeas.)
5. The first injurious effect of CS_2 on seeds is a retardation of germination.

[6]Report of the Institute of Phytopathology at Wageningen 1915.

6. It seems that liquid CS_2 poured on most seeds in fumigation will not injure them sufficiently to be of practical importance.

In the directions for killing insects with CS_2 a warning is usually included that the bin should be aired out within a short time or the germination of the seeds is likely to be injured. In the writer's experience in preserving hundreds of small lots of seeds free from insect attack it was often inconvenient to do this. This suggested the problem of testing the resistance of our common seeds to injury by bisulphide in order to discover within what limits the treatment could be varied without injuring the seeds.

E. A. de Ong reported in this JOURNAL (Vol. 12, pp. 343–345) that most common seeds would withstand treatment at the rate of 30 pounds per thousand cubic feet for 42 hours or at 40 pounds per thousand cubic feet for 18 hours. Some ten other references on this subject were found in the literature but none of them carried the treatment very far either as to excessive doses or excessive length of time.

Methods. The seeds were treated in two-quart Mason jars with the usual rubber ring seals. When the seeds were exposed a week or more the rubber ring was coated with paraffin to reduce the solvent action of the bisulphide on the rubber and then the seal coated with paraffin after the jars were closed. The bisulphide was dropped into the jars from a burette on sufficient filter paper so that the liquid bisulphide did not touch the seeds. Two-tenths cc. of bisulphide to the two-quart jar is equivalent to one pound to 118 cubic feet and was considered the normal dose. For the treatment with a saturated atmosphere of CS_2 a four ounce bottle partially filled with bisulphide was carefully lowered into the jar before sealing it. The same amount of grain (one pint) was placed in each jar. The work was carried out at a constant temperature of 80° F.

TABLE 1. TESTS OF SEEDS TREATED WITH 1.6 CC. PER JAR (68 POUNDS PER 1000 CUBIC FEET) FOR 21 DAYS

Seed Used	Total Germination Check	Total Germination Treated	Seed Used	Total Germination Check	Total Germination Treated
Red Clover	78	73	Dent Corn (4 weeks)	100	100
Alsike Clover	80	81	Barley, Oderbrucker	95	81
White Sweet Clover	48	43	Barley, White Hulless	98	32
Hairy Vetch	71	67	Sweet Corn	94	76
Garden pea, Marrowfat	100	94	Oats, Miami	88	58
Field peas, Canada	94	84	Wheat, Portage	97	23
Soybeans, Manchu	96	66	Rye	72	49
Cowpeas, Black	84	38	Sorghum, Early Amber	95	31
Cowpeas, Blackeye	96	0	Buckwheat	94	0
Navy beans	98	0	Timothy	97	67
Garden Beans, White Kidney	94	0	Kentucky Bluegrass	83	64
Garden Beans, Black Wax	96	84	Redtop	91	88

Data. In order to discover which seeds were most susceptible to carbon bisulphide treatment a number of kinds of seed were treated with 1.6 cc. per jar (68 pounds per thousand cubic feet) for twenty-one days. The results are given in Table 1.

As a result of this treatment there is every gradation from no effect whatever in the case of corn and alsike clover to a total loss of germination in the case of buckwheat, black-eyed peas and navy beans.

As a result of this preliminary test systematic tests varying the length and severity of the exposure were started with corn, wheat, buckwheat and navy beans. The results are given in the following tables:

Table 2. Corn Treated with CS_2 Vapor

Dose	Number of days exposure 7	14	21	28	42	56
.6 cc.	100	98	93	100	100	100
1.6 cc.		99		100		100

Average check germination 100.

Table 3. Wheat Treated with CS_2 Vapor

Dose	Number of days exposure 2	4	8	16	24	32	64
.2 cc.	98	100	99	97	96	98	96
.4 cc.	98	99	98	99	90	99	98
.8 cc.	97	98	99	100	92	99	98
1.6 cc.	99	97	96	99	76	95	92
3.2 cc.	98	93	87	93	62	95	31
Saturated atm.	86	85	73	73	20	29	0

Average check germination 99.

Table 4. Buckwheat Treated with CS_2 Vapor

Dose	Number of days exposure 2	4	8	16	24
.2 cc.	98	99	99	95	94
.4 cc.	98	96	97	99	96
.8 cc.	93	99	97	96	96
1.6 cc.	95	100	95	99	97
3.2 cc.	95	94	100	94	93
Saturated atm.	96	95	91	87	71

Average check germination 99.

Table 5. Navy Beans Treated with CS_2 Vapor

Dose	Number of days exposure 2	4	8	16	24
.2 cc.	84	86	90	76	70
.4 cc.	86	78	86	76	66
.8 cc.	88	78	86	74	64
1.6 cc.	83	68	76	68	32
3.2 cc.	82	70	56	56	1
Saturated atm.	67	42	30	6	0

Average check germination 85.

Dent corn was not affected by any treatment used. The other seeds were more or less injured, the injury increasing with the length of exposure and the size of dose, though not in any definite ratio.

However, the seeds were more injured by the bisulphide than appears in these tables. The first effect of the treatment was to delay germination one or more days later than the check. The delay was due to a definite injury to the seeds as is shown by the fact that a treated sample showed the same delayed germination a year after the treatment. A few examples from the large amount of data secured are given in Table 6.

Table 6. Data to Show Retardation

Seed and Treatment	Number germinated							
	2	3	4	5	6	7	8	Total
	days after test was started							
Timothy, check		60	30		7			97
Timothy, 1.6 cc. for 21 days		0	21		66			87
Buckwheat, check		91	2					93
Buckwheat, 24 days, 3.2 cc		66	25	2				93
Buckwheat, 24 days, Saturated atm		14	20	0	8	16	13	71
Wheat, check	77	22						99
Wheat, 16 days, .2 cc	78	19						97
Wheat, 16 days, .4 cc	46	53						99
Wheat, 16 days, .8 cc	56	44						100
Wheat, 16 days, 1.6 cc	21	74		4				99
Wheat, 16 days, 3.2 cc	19	84		7				93
Wheat, 16 days, Saturated atm	4	34		32		3		73

In the wheat series the sample treated with .8 cc. and 1.6 cc. both made a total germination equal to the check yet they were definitely injured by the treatment as shown by the delayed germination. In the timothy series on the third day it appeared that the treated seed was entirely killed. Finally there was only ten per cent difference between the check and the treated sample. Whether the subsequent development of these slow germinating seeds would be normal has not been determined. The seedlings appeared perfectly normal on the blotters.

Table 7. Seeds Immersed in Liquid CS_2 for Various Periods

	Check	Treated
Corn, 24 hours	100	100
Corn, top of kernel cut off, 24 hours	100	100
Corn, top of kernel cut off, 8 days	100	86
Corn, punctured over scutellum, 24 hours	100	88
Corn, 10 days	100	92
Corn, 30 days	100	88
Wheat 2 hours	97	79
Wheat, 20 hours	97	44
Wheat, 43 hours	97	34
Oats, 24 hours	95	65
Soybeans, 24 hours	86	70

A point of importance in practical fumigation is the amount of injury which may be expected if the liquid bisulphide touches the seeds. It is commonly assumed that the injury will be much greater in this case. A few experiments conducted to test this are reported in Table 7.

Apparently there is no likelihood of injuring corn by any commercially practical treatment with bisulphide, since it withstood 30 days immersion in bisulphide with a loss in germination of only twelve per cent. Even then the seedcoat was punctured directly over the scutellum of the germ, 88 per cent of those immersed in bisulphide for twenty-four hours germinated. The other seeds showed much greater injury from immersion in the liquid than from treatment with the gas, but the injury was not sufficient to suggest any practical danger from pouring bisulphide directly on seeds for fumigation. In practice, we have done this for years without injury.

ON THE OYSTER-SHELL SCALE FOUND ON WILLOWS AT BOULDER, COLORADO[1]

By R. L. Shotwell, *Boulder, Colo.*

A heavy infestation of the Oyster Shell Scale (*Lepidosaphes ulmi*) has recently been discovered on willows in a small half-acre clump in Gregory Canon, Boulder, Colorado. The altitude of this particular spot is about 5600 feet. This insect has also been reported from other parts of the state, Fort Collins and Denver. That the insect was brought from Denver to this place on the feet of birds is the opinion of Dr. T. D. A. Cockerell.

The following trees and shrubs are found in the vicinity of the infested willows: two species of Populus (broad-leaf and narrow-leaf cottonwoods), Pinus (western yellow pine), Alnus (alders), Crataegus (thorn-apple), Prunus (wild plum), Acer (Rocky Mountain maple and box elder), and rosebushes. All of these are in close proximity to the willows, but do not have any of the insects on them. One small rosebush had a few scattered scales on it, but they were poorly developed. Prof. C. P. Gillette of Ft. Collins writes: "The lilac and ash trees in a city park in Ft. Collins are being killed by this scale, while a number of flowering crabs growing under these trees do not have any of the scales upon them. In fact we do not find *Lepidosaphes ulmi* on any of the apple trees here."

The following table shows the difference in the average number of

[1]Contribution from the Entomological Laboratory, University of Colorado.

circumgenital pores between specimens taken from willows in Gregory Canon, and those taken from Populus and Salix in Italy (Berlese and Leonardi; Chermotheca Italica) and Peach in Florida (Rolf and Quaintance, Coccidae Americanae). This table was worked out according to the method of Mr. P. A. Glenn in an article, "Forms of the Oyster Shell Scale in Illinois," JOURNAL OF ECONOMIC ENTOMOLOGY, April, 1920, 13:173–177. From a comparison of the two tables, this scale in Gregory Canon comes under what Mr. Glenn calls the grayish brown or banded form. The Italian specimens from the Populus and Salix fall in with his yellowish brown form, and those from the peach, with his brown or apple form. In this table the mode represents the number of pores found to occur most commonly in any one group. The averages and modes in most cases are very nearly the same. The variation curves for the number of pores in the different groups of specimens from the willows were also worked out according to the method of Grace H. Griswold (1922). These curves indicated that the Gregory Canon scale belongs to the lilac form though the modal number is higher. Presumably, therefore, it is not to be found as an enemy to the apple.

CIRCUMGENITAL PORES

Host Plant	Number examined	Posterior Lateral				Anterior Lateral				Median Group				Total average
		Max.	Min.	Aver.	Mode	Max.	Min.	Aver.	Mode	Max.	Min.	Aver.	Mode	
Willow, Boulder, Colo.	75	32	10	21.94	24	30	14	24.28	25	16	6	12.95	14	105.39
Willow, Boulder, Colo.	17	28	19	23.40	24	30	21	25.20	25	17	11	14	14	111.20
Populus, Italy	13	17	15	15.73	16	24	15	20.90	21	13	10	11.16	10	84.42
Salix, Italy	16	20	12	16.84	16-17	27	15	20.37	18-19	14	10	11.50	12	85.92
Peach, Florida	13	25	12	14.16	12-13	22	12	16.43	16	11	9	10.54	10	71.72

REFERENCES

GLENN, P. A. Forms of the Oyster Shell Scale in Illinois. Jour. Econ. Ent., April 1920, 13; 173–177.

GRISWOLD, GRACE H. Are there two species of the Oyster Shell Scale. Annals Entomological Society of America, June, 1922, XV:184–191.

GILLETTE, C. P. Letter of Jan. 9, 1923.

Scientific Notes

The Oriental Peach Moth, *Laspeyresia molesta* Busck. During the past two summers this insect has been noticeable on apple and peach. At times it has been more injurious than the lesser apple worm. This summer it has been found injurious especially on peach shoots, causing alarm to some orchardists in Adams County, Pa.

S. W. FROST, *State College, Pa.*

An Outbreak of the Apple Flea-Weevil. An outbreak of the "Apple Flea-Weevil" *Orchestes pallicornis* Say., has been found by Anthony Berg at Morgantown, West Virginia. Forbes (1911) first recorded it as a pest on apple under the name *Orchestes canus* Horn. The larvae mine the leaves of apple, cherry, elm and alder and the adults feed on the foliage, eating out small holes. The larvae transform in gall like pockets within the leaves. Larvae were reared at the State College laboratory Arendtsville, Pa., and the adults issued between June 8th and June 11th. The adults resemble flea beetles more than Curculionids in habits because their hind legs are enlarged and they are powerful jumpers. Records have been made of the adults feeding on the flowers of Amelanchier and on the leaves of willow. The species is widely distributed although is it not often taken as a pest. Mr. A. B. Champlain, who kindly determined the species, states that there is a long series of the species in the State Collection at Harrisburg. S. W. Frost.

Note on Occurrence of *Macrosiphum pisi* Kalt. on Scotch Broom. During the summer and early fall of 1921 a search was made on all wild legumes that might possibly serve as hosts for *Macrosiphum pisi* Kalt. October 7th, in the vicinity of Forest Grove, Oregon, males (both alate and apterous), oviparous females, and eggs of this aphid[1] were found on Scotch broom (*Cytisus scoparius*) which commonly grows wild in western Oregon and Washington as an escape from cultivation. It is especially abundant towards the seacoast where in places it lines the roadside for miles. Broom as a possible host for *Macrosiphum pisi* Kalt. was suggested by Mr. L. P. Rockwood because of its having been listed as a host for that aphid in Europe (Kaltenbach, 1874), though, so far as the writer knows, it has not been so listed for this country.

Eggs on broom began hatching March 11, 1922, the first stem mothers maturing April 25th. Alates appeared towards the end of the third generation (about June 1st) and in the fourth generation, but, contrary to expectations, they did not leave the broom this season, at least not in appreciable numbers. The fact that there was no vetch (their usual herbaceous host in this region) in the immediate vicinity may have had something to do with this. Most of the succeeding generations were apterous, the aphids continuing on broom during the entire summer, and sexual forms first appearing about September 18th, 1922, on which date two wingless males and one nymph were swept. Several oviparous females and males were taken two days later, and the first eggs were found September 23d. Oviparous females were much more numerous than males during this season, and the apterous males in turn were more abundant than the alate form. Viviparous females continued, along with the sexual forms, on the broom during the fall, all apparently disappearing early in December.

The aphids feeding on broom are somewhat smaller and of a duller green than those feeding on vetch, but in all other respects they are identical, and will readily transfer to vetch or clover. They will also reproduce on alfalfa and locust under insectary conditions, sexual forms and eggs being secured on the latter host.

The occurrence of *Macrosiphum pisi* Kalt. on broom is quite general in western Oregon and Washington, and the aphids have been collected from that host at Olympia, Kent, Tacoma, and McGowan, Washington; Eugene, Dallas, Forest Grove, Portland, Astoria, and Seaside, Oregon.

[1]Determined by A. C. Baker of the Bureau of Entomology.

Macrosiphum pisi has been very destructive at times on vetch and peas in the Northwest, an especially severe outbreak occurring in 1918.

SADIE E. KEEN *U. S. Bureau of Entomology, Forest Grove, Ore.*

Swarms of Aphids: During the week ending June 9, newspapers and telephone inquiries reported that swarms of aphids were present in the cities of Meriden and Waterbury, Conn., and on June 8, specimens were received from Waterbury. On June 8, Mr. Zappe collected specimens at his home, Mount Carmel, where they were so abundant in the air that his little daughter said to him: "Daddy, it's snowing." During the week ending June 16, similar swarms of aphids appeared in the center of the city of New Haven, and the writer observed them on Elm Street on the afternoon of June 16. The tops of automobiles and clothes were literally covered with aphids and pedestrians were brushing them from their faces. Mr. Rogers of this Department states that in Bridgeport swarms of aphids have been present for three weeks, and that one day in the city in catching a butterfly he also caught two or three hundred of these aphids in the net. Even at the date of this writing (July 3) aphids have not all disappeared in New Haven, and this morning Mr. Rogers ran into a swarm on Winchester Avenue. It is not certain that all of these aphids were of the same species, but those examined seemed to be identical and material submitted to Dr. A. C. Baker of the Bureau of Entomology has been identified as *Euceraphis deducta* Baker, a species described from Maine in 1917 (JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. X, page 429). Birch is the host of this species and the swarms probably came from *Betula populifolia*, which is abundant around all of these Connecticut cities. In 1919, I recorded the presence of swarms of *Calaphis betulaecolens* Fitch (see JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. 12, page 351) in New Haven, Conn., and at first I supposed the swarms of the present season were of that species. A microscopic examination, however, showed them to be different. Dr. Baker writes that "it is very interesting that this recently described species should become so abundant."

W. E. BRITTON

A Note on the Life History of the San Jose Scale (*Aspidiotus perniciosus*) in the South. It has been the consensus of opinion among entomologists that the winter is past by the San Jose scale in a half-grown condition. Numerous observations on this part of the insect's life history in northern latitudes prove this opinion to be well founded, however, in the South it has been found that the insect frequently passes the winter or parts of the winter as a full-grown adult. In taking data on the results of experiments for the control of the San Jose scale on peach trees in Georgia during the winter of 1922–23 both crawlers and full-grown females were observed on peach twigs during the months of January, February, and March. During these months the crawlers were noted to settle down and start the formation of the scale covering a few hours after emergence in the same manner as those that emerge during summer months. Several years previous both crawlers and full-grown females were observed on peach trees in Mississippi during November and December. The first winged male to be observed in Georgia during the winter of 1922–23 issued on Mar. 27, 1923. All stages of the San Jose scale from the crawling young to the full-grown females have therefore been observed each month during the winter in the South, and it is evident that in the latitude of the Gulf States the San Jose scale breeds almost con-

tinuously during a mild winter, and the increase during such years is remarkably rapid unless properly controlled by sprays.

Oliver I. Snapp and C. H. Alden,
U. S. Bureau of Entomology, Fort Valley, Georgia

The Green June Beetle (*Cotinis nitida* L.) as a Tobacco Pest. In spite of the fact that we have had two excellent bulletins devoted to this common southern pest within the last two years, I have been unable to find any mention of this insect as a tobacco pest. Yet I believe that it is not only a very common, but a very serious pest of tobacco beds in North Carolina, and undoubtedly in many other sections of the South. I have had reports for a number of years of serious injury to tobacco beds by "earthworms," but all such reports were made in the winter so that they could not be investigated. This past year, however, I was fortunate enough to trace these "earthworms" to their lair and found that they were the larvae of the common Green June Beetle (*Cotinis nitida L.*).

Tobacco beds offer ideal breeding grounds for the Green June Beetle, as the beds are invariably placed in new ground or other rich soil and heavily fertilized with stable manure. Perhaps the chief reason that this insect is not more injurious is that it is a common practice to move tobacco beds to a new location each year.

The injury to the tobacco plants by the larvae of the Green June Beetle consists not only of the disturbance to the root system by their tunnelling, but the actual destruction of the roots and stems as has been reported by other workers for common vegetables.

The best remedy for this pest on tobacco beds would seem to be the method of changing the location of the bed each year. If the bed must be placed in the same location, year after year, the best remedy is to spade the bed thoroughly, early in September and sterilize the soil with steam or spray it with kerosene emulsion.

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

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One hundred separates or reprints at $2.50 per page or plate. Additional hundreds or less, 4 pages or less, $1.00; 5-8 pages, $1.50; 9-12 pages, $1.75; 13-16 pages, $2.00; 17-24 pages $3.00; 25-32 pages, $4.00. Covers suitably printed on first page only, 100 copies, or less, $4.50; additional hundreds, or less, $1.75. Plates inserted, $1.75 per hundred, or less. Folio reprints, the uncut folded pages (50 only), sixteen page signature, or less, $3.00.

Ventures into the unknown are by no means always happy. Such was the case in the recent attempted test in New Hampshire of the possibility of utilizing a dirigible for the application of a poisonous dust to forest trees. It was especially vexatious that a thorough test was so nearly accomplished. The incident simply emphasized the uncertainty of investigational work and by no means suggests that further efforts along this line are inadvisable, in spite of the months of work and planning rendered fruitless by untoward developments. It appears practicable to utilize some device for dusting forest trees from above. It is possible that the type of dirigible selected was not the best for the purpose in view. Some modification may bring about the desired result. There is no question as to the desirability of developing equipment which can be used, possibly in special cases only, for dusting forest trees from above. If there are no planes or balloons moderately well adapted to the purpose, modifications might be developed. It may be necessary to abandon both planes and balloons and solve the problem in an entirely different manner. It is evident that there is an increasing need for a relatively inexpensive method of destroying leaf feeding caterpillars in densely forested areas. The high powered spraying equipment of the present day represents a long step in advance of the methods of some years ago. Is it not reasonable to look for another step in the near future? We use water as a carrier. We are employing air as a distributor of poison. Is it not reasonably safe to ride on the "wings of the wind" and at the same time scatter an insecticide effectively? Possibly not with the present equipment. Is it too much to look for the development of such a method within five years?

Obituary

FRANK CUMMINGS COOK

Dr. F. C. Cook of the Insecticide and Fungicide Laboratory of the Bureau of Chemistry died in Dallas, Texas, June 19 following an operation for appendicitis. Death occurred as would undoubtedly have been the desire of one so enthusiastic and full of energy without illness long removing him from his work. In fact he was busily engaged in going over plans for investigations in the field and other preparations for the trip only forty hours before he was called upon to lay aside his labors permanently.

One of the most successful and pleasant cooperative undertakings among scientific men was begun in 1913 when the Bureau of Chemistry, Bureau of Entomology and Bureau of Plant Industry, with Dr. Cook representing the first, began a series of experiments in the destruction of fly larvae in manure. This investigation was continued through several seasons and resulted in the discovery of very successful methods of preventing fly breeding in manure by the application of borax or hellebore. These methods are now being applied extensively by entomologists and sanitarians in the United States and various parts of the world. This project completed, Dr. Cook was assigned to work on arsenicals in cooperation with Dr. McIndoo of the Bureau of Entomology and the results of this work have just appeared as Department Bulletin 1147, "Chemical, Physical and Insecticidal Properties of Arsenicals." During 1921 Dr. Cook began cooperative work with the Bureau of Entomology on the chemotropic responses of flies. The field investigations on this project were carried out in Texas since the immediate practical problem was the development of attractants and repellents for the protection of live stock from infestation by screw worms. A portion of three seasons was spent in Texas on this project and it was while engaged in this work that the fatal illness occurred. Very substantial progress was made in this investigation although only a preliminary report (Jour. of Econ. Ent., vol. 16, pp. 222-224) has been issued. Another cooperative project with the Bureau of Entomology in which Dr. Cook was engaged was the testing of various fumigants with a view particularly of finding more satisfactory methods of destroying insects in cars of grain.

Dr. Cook displayed marked versatility in his work and the rapidity with which he grasped the entomological aspects of a problem made him especially valuable in these investigations.

Dr. Cook entered the Bureau of Chemistry in 1904. He was a native of Connecticut and educated in Yale where he received the B. A. degree in 1900, M. A. in 1902 and M. S. 1904. In 1908 the Ph.D. degree was conferred upon him by the George Washington University. He was a delegate to the International Congress of Applied Chemistry, Rome, 1906 and London, 1909, and was a member of numerous chemical and other scientific societies.

He published numerous papers, some in collaboration with Drs. Wiley and Bigelow on the chemistry of food products, cold storage experiments with eggs, fowls, etc., enzymes, food metabolism, and the use of copper sprays and their effects on the growth and composition of potatoes.

In the untimely death of Dr. Cook the sciences of Chemistry and Entomology have sustained a most serious loss. His many associates in the Department, all of whom were his devoted friends, feel most keenly the loss of contact with this enthusiastic and energetic worker, his genial, buoyant personality and clean christian life.

F. C. B.

Current Notes

Dr. W. D. Hunter of the Bureau of Entomology, addressed the annual meeting of the Western States Plant Quarantine Board at Phoenix, Ariz., May 22.

Mr. A. E. Miller has started a series of experimental plantings of corn at Chillicothe, Ohio, to determine the comparative immunity from the attacks of corn ear-worm.

C. H. Hadley has been appointed Director of the Bureau of Plant Industry of the Pennsylvania Department of Agriculture.

Professor S. A. Forbes is spending the month of August in scientific work at Bowdoin College, Brunswick, Maine.

Mr. J. S. Houser, Associate Entomologist of the Ohio Experiment Station, visited the Kansas State Agricultural College during Commencement Week, May 26 to June 1. Mr. Houser graduated with the 1904 class.

The alfalfa weevil scouting work in Southern Alberta started under the immediate direction of Mr. H. L. Seamans on June 5th. Messrs. J. E. Featherstonnaugh and R. D. Murdock are doing the actual field work.

Prof. Z. P. Metcalf of North Carolina State College and Experiment Station has been granted a leave of absence and will spend the summer in study at the Bussey Institution, Forest Hills, Boston.

Dr. J. W. Bailey of Bussey Institute, Harvard University, is assisting Dr. F. C. Craighead for a few weeks in the study of the physiological conditions accompanying the death of budworm-injured balsam and spruce in Canada.

Dr. F. C. Craighead, accompanied by Dr. J. W. Bailey and R. C. Balch, recently appointed as temporary investigator of insect pests, left Ottawa on May 31st for a ten day study at the balsam sample plots at Long Lake, Que.

Dr. J. G. Needham, head of the Department of Entomology, Cornell University, was at the Kansas State Agricultural College July 5th and 6th, at which time he gave three addresses to the students and faculty of the summer school.

According to *Science*, Dr. William Morton Wheeler and other members of the Williams Galapagos Expedition arrived in New York the last week in May after a ten-week cruise among the Galapagos Islands, off the coast of Ecuador.

The scouting to determine the distribution of the apple sucker started in Nova Scotia on June 5th. Prof. W. H. Brittain is in immediate charge of the work and will be assisted by Messrs. George Makinson, and Mr. L. A. Coite.

Messrs. Luther Brown and J. H. Pressley of the Georgia State Board of Entomology are assisting with control experiments of peach insects that are being conducted at Fort Valley, Georgia, by the Bureau of Entomology in cooperation with the State Board.

Mr. C. H. Hadley, Jr., of the Bureau of Entomology, and in charge of the Japanese beetle work at Riverton, N. J., has been appointed Director of the Bureau of Plant Industry, Department of Agriculture, Harrisburg, Pa., and has already begun his work there.

Mr. A. C. Morgan, Bureau of Entomology, in charge of the Tobacco Insect Laboratory at Clarksville, Tenn., addressed gatherings of Burley tobacco growers in Gallatin, Columbia, and Shelbyville, Tenn., May 31 to June 2, his subject being the control of tobacco insects.

A report has been received from the north shore of Gaspe Peninsula that additional injury by *Dendroctonus piceaperda* has been discovered in several important stands of spruce. It is expected that this infestation will be investigated by Canadian officers in the near future.

Prof. A. E. Stene, State Entomologist and Director of extension work for Rhode Island, attended the Tri-State Conference of extension workers at Amherst, Mass., June 27–29, and the field meeting of the Connecticut Vegetable Growers' Association at New Haven on July 7.

Mr. C. M. Smith, detailed from the Bureau of Chemistry to investigate the chemical and physical properties of calcium arsenate and the influence of various factors in the application of this insecticide to the cotton plant, has started on field work for the season at Tallulah, La.

Prof. Dwight M. DeLong of the Ohio State University has been raised from the rank of Assistant Professor to Professor of Entomology, and will have charge of the teaching work in Economic Entomology at that institution.

According to *Science*, Mr. E. M. Ehrhorn, Entomologist, Board of Commissioners of Agriculture and Forestry, Honolulu, H. I., has been appointed by the National Research Council as one of the American Delegates to the Second Pan Pacific Scientific Congress to be held at Sydney and Melbourne, Australia, from August 13 to September 3.

Mr. C. H. Popenoe, Bureau of Entomology, Entomologist in Truck-Crop Insect Investigations, has been authorized to devote his entire time to fundamental re-

search work in insect behavior and chemical control, and will establish headquarters at the laboratory at Sligo, Md., where investigations of fruit insects and truck-crop insects are being conducted.

At the Connecticut Agricultural Experiment Station, New Haven, Mr. R. C. Botsford is now in charge of the mosquito work in place of Samuel T. Sealy, who resigned April 1. Messrs. J. Leslie Rogers and T. J. Cronin are employed temporarily in the Entomological Department to assist in the field experiments and in nursery inspection.

Mr. L. L. Huber is in charge of the laboratory for the investigation of the European Corn Borer at Geneva, O. Plantings of varieties of early corn to test maturing qualities and comparative immunity from attack are now being made. Life-history cages will be started as soon as material can be collected for this purpose.

On April 30, Dr. F. C. Craighead of the Canadian Entomological Branch left for Fort Francis, Ont., to meet Dr. S. A. Graham of the University of Minnesota, and visit the area attacked by the spruce-budworm. It is expected that a cooperative study of the outbreak in western Ontario and northern Minnesota will be arranged.

For the purpose of cutting down expenses, some of the work of the Bureau of Biological Survey has been curtailed and Mr. Henry L. Viereck has been obliged to seek a position elsewhere. At present he is employed temporarily in systematic work with Hymenoptera at the Entomological Branch, Canadian Department of Agriculture, Ottawa, Can.

Recent appointments in the Entomological Branch, Canadian Department of Agriculture, have been announced as follows:—T. Armstrong, Assistant Junior Entomologist for the Montreal district, vegetable crop insects: N. J. Atkinson, temporary entomologist, Saskatoon Laboratory: G. A. Ficht, temporary junior entomologist, Port Stanley Laboratory: R. Ogburn, seasonal assistant, systematic entomology to collect insects, particularly Ephemeridae and Odonata around Ottawa.

Mr. C. R. Neiswander has been appointed to assist Mr. Huber in the corn borer investigations, of the Ohio Station. Mr. Neiswander has his master's degree from Ohio State University. He commenced work at the Geneva Laboratory May 30. Messrs. Huber and Neiswander came to Wooster June 6 to get further equipment for the Geneva laboratory.

Mr. W. H. White, Bureau of Entomology, has just returned from Seaford and other points in Delaware, where, in company with C. C. Woodbury of the National Canners Association, he made general observations tending toward a better knowledge of the practical control of the pea aphis on cannery peas with nicotine dusts, applied by high-power apparatus.

Mr. J. E. Dudley, Jr., Bureau of Entomology, in charge of the investigation of the pea aphis in its attacks on cannery peas, has been authorized to assume temporary headquarters at Columbus, Wis., where he will undertake cooperative control experiments and studies throughout the pea-growing season, in cooperation with State Entomologists and the Columbus Canning Co.

Messrs. W. D. Edmonston and George Hofer of the Bureau of Entomology are at present on the Kaibab National Forest and Grand Canyon National Park, where control work is being conducted in cooperation with the Forest Service of the De-

partment and the National Park Service of the Interior Department against the Black Hills beetle, *Dendroctonus ponderosae* Hopk.

The Department of Entomology of the Ohio Station is giving the red engine oil emulsion which has proven so successful in controlling severe outbreaks of San Jose scale in Illinois and Arkansas a thorough trial in Ohio. This season tests on apple are being conducted at Painesville, Youngstown and Chesapeake; on peach at Danbury; and on plum and currant at Waterville.

Many arborvitae and boxwoods in the vicinity of Washington, D. C., are suffering from attacks by two leaf-miners—the lepidopterous arborvitae leaf-miner and the dipterous boxwood leaf-miner. Mr. William Middleton of the Bureau of Entomology is investigating these insects in this locality, particularly the infestation of the arborvitae leaf-miner in the Arlington National Cemetery, Arlington, Va., where it is especially severe.

It is announced that Dr. F. C. Craighead has been appointed head of the Division of Forest Insects of the Bureau of Entomology, beginning about September 1, 1923. Dr. Craighead was formerly connected with the Bureau, but resigned a few years ago to accept a position in the Entomological Branch of the Canadian Department of Agriculture, where he has since been specializing in forest insect work.

The following recent appointments to the Bureau of Entomology have been announced: John F. Cotton, Cornell University, laboratory aid for the summer, stored-product insects; Victor Duran, truck crop pests; A. D. Shaftsbury, Bruce Lineburg, Paul E. Smith, Effie Marie Ross, Mary G. Rozelle, Professor L. M. Bertholf of the North Carolina College for Women, and B. Kurrelmeyer of Johns Hopkins University, temporary assistants in bee culture investigations.

Dr. J. H. McDunnough, Chief of the Division of Systematic Entomology, Canadian Department of Agriculture, spent May 1 and 2 in Toronto, examining some of the type specimens of Ephemeridae in the Toronto University Museum. On May 7 he left for Boston, Mass., to examine types and specimens of interest in various orders in the collections at the Boston Museum of Natural History, and the Harvard Museum at Cambridge.

According to the *Official Record*, Mr. John E. Graf has been made acting head of the Division of Truck Crop Insect Investigations of the Bureau of Entomology. Mr. Graf has recently been located at Birmingham, Ala., but will now be at Washington. Dr. F. H. Chittenden, who for many years has been in charge of this Division, will devote his time in the future to special studies of truck crop insects and to taxonomic work.

The Tri-State Conference of extension workers of Massachusetts, Rhode Island and Connecticut was held at Amherst, Mass., June 27–29. The following papers were presented before the conference by entomologists:—Apple and Thorn Skeletonizer and Eur pean Red Mite, by W. E. Britton: Present Status of Gipsy Moth Control by A. F. Burgess: The Organization and Work of the Crop Protection Institute by W. C. O'Kane: Discussion of Orchard Insect Pests with Specimens, by Arthur I. Bourne.

Mr. R. A. St. George of the Bureau of Entomology, left Washington May 20 for points in Kentucky, Georgia, Mississippi and Alabama, to supervise the cooperative experiments with lumber companies intended to prevent insect damage to green logs and lumber by ambrosia beetles and borers, and also damage to seasoned products by

Lyctus powder-post beetles. Mr. St. George is also to report on the present status of an epidemic of the southern pine beetle, *Dendroctonus frontalis* Zimm.

According to *Science*, the attention of entomologists throughout the world is called to the fact that, beginning with the volume for 1922, the preparation of the "Insecta" part of the *Zoological Record* is being undertaken by the Imperial Bureau of Entomology. In order that the *Record* may be as complete as it is possible to make it, all authors of entomological papers, especially of systematic ones, are requested to send separata of their papers to the bureau. These are particularly desired in cases where the original journal is one that is not primarily devoted to entomology. All separata should be addressed to the assistant director, Imperial Bureau of Entomology 41 Queen's Gate, London, S. W. 7, England.

Mr. W. N. Keenan of the Division of Foreign Pests Suppression spent ten days in Southern Ontario in connection with the European corn borer work, where he arranged for the inspection of cut flowers and vegetables for export to the United States and also for the maintenance of the quarantine. Warning posters are being placed at all road intersections leading out of the quarantined area, informing the general public that it is against the law to remove corn from the infested districts.

An experimental demonstration was started by the Bureau of Entomology nearly two years ago with a local bsuiness firm, in which the Bureau undertook to eliminate loss for the two-year period to stocks of brushes by fumigation with hydrocyanic acid gas. The company provided a room in which to store their stocks and in which they could be fumigated without moving. The experiment has demonstrated the possibility of preventing losses of this kind by the methods adopted, and the company has been the gainer by several thousand dollars annually.

The temporary parasite laboratory at St. Thomas, Ontario, with Mr. A. B. Baird in charge, is now well under way and owing to the extensive and well organized "clean-up" campaign, instituted by the Division of Field Crop and Garden Insects, it has been a difficult task to secure enough hibernating European corn borer larvae for the breeding of the parasites. By transferring men from other lines of work it was possible to collect 26,000 larvae up to June 1st. Mr. H. A. Dyce of the University of Toronto, has been appointed to assist Mr. Baird.

Dr. H. L. Dozier resigned his position as Entomologist, U. S. Bureau of Entomology in charge of the Camphor Scale Investigation Laboratory at New Orleans, La., April 1st, to accept the position of Entomologist for the Gulf Coast Citrus Exchange in charge of their research and field service problems, dealing primarily with the Satsuma orange. A fully equipped office and laboratory has been established at Houston St., 1 S. of Government, Mobile, Ala., to carry out these investigations. Much progress has been made during the past fall and winter in cleaning up the purple and camphor scale on the Satsuma orange in Southern Alabama, using standard oil emulsions.

The following amendments to the Regulations under the Canadian Destructive Insect and Pest Act were recently passed: Amendment No. 19, passed May 31, 1923, prohibiting the importation of certain cut flowers and vegetables from the areas infested by the European corn borer in the United States (Amendment brings up to date the old regulation). Amendment No. 20, passed June 4, 1923, amends the previous regulation by adding European Buckthorn (*Rhamnus cathartica* L.) to the list of plants prohibited entry, on account of its being a host of the disease causing

crown rust of oats. Amendment No. 21, passed June 4, 1923, a domestic regulation amended by adding European Buckthorn to the list of plants prohibited entry into Manitoba, Saskatchewan, and Alberta from the other provinces of Canada.

Dr. J. M. Swaine, Associate Dominion Entomologist, left Ottawa on April 24 for a ten days' trip to Washington, Philadelphia, New York and Boston, for the purpose of comparing specimens of the genus *Leptura* with types located in the various museums in the cities mentioned. This work is preparatory to a revision of the genus which Dr. Swaine is undertaking in cooperation with Mr. Hopping. Dr. Swaine arrived in Washington during the first part of May. Dr. Hopkins showed Dr. Swaine the Forest Insect collections, particularly the Scolytidae. Dr. Swaine also visited the Eastern Field Station at East Falls Church, Va. On May 2 Dr. Swaine with Dr. Snyder visited Ashland, near Richmond, Va., where control operations were being conducted against the southern pine beetle, *Dendroctonus frontalis* Zimm. Termites or white ants were found to constitute, as usual, one of the principal factors in rapidly rendering standing beetle-killed timber unmerchantable.

The Louisiana Entomological Society was organized with 26 members three years ago, largely through the efforts of Mr. Ed. Foster of New Orleans who has served as President for the past three years. While no special effort has been made to secure new members, the membership has grown to 47, including one honorary member, Dr. L. O. Howard, Chief of the Bureau of Entomology, U. S. Department of Agriculture. Meetings are held five times a year, four being held in New Orleans and one in Baton Rouge. The Society was organized by professional entomologists of the State, for the purpose of advancing knowledge of insects and the Society always welcomes, either as members or visitors at meetings, those who are interested in insects. With this in mind it has been the policy to arrange programs, consisting of short talks, moving pictures, and insect exhibits, that will appeal to all those interested in insect life. Officers for the present year are:—President, T. H. Jones, Entomologist of the Experiment Station, Louisiana State University; Vice-President, Dr. H. T. Mead, Professor of Zoology, Tulane University; Secretary-Treasurer, Ed. Foster, New Orleans; members of Executive Committee, E. R. Barber, Barber Entomological Laboratories, New Orleans, James M. McArthur, New Orleans, and W. G. Bradley, Assistant Entomologist, Experiment Station, Louisiana State University; Publicity Secretary, E. R. Barber.

Prof. James G. Sanders severed his connection on July 1 with the Pennsylvania Department of Agriculture, where since 1917 he has been Director of the Bureau of Plant Industry. He came to Pennsylvania from the University of Wisconsin at the request of the Agricultural Commission to organize the nursery inspection service, and to establish a Bureau of Economic Zoology (later becoming the Bureau of Plant Industry), which should provide a means for controlling insect and plant disease outbreaks, and in addition be a valuable factor in the economic field of entomology and plant pathology in the state. Since that time the Bureau has been built up in various directions to include such activities as: the building of a fine insect collection, the establishment of a state herbarium and a plant disease collection, the organization of seed inspection, apiary inspection, nursery inspection, and potato seed certification, and the equipment of five field laboratories for research into the control of insects and diseases. His well known energy and ability have been important factors in dealing with two of the most outstanding national quarantine problems of

recent years, namely the potato wart and the Japanese beetle, and the success of enforcement in these is in no little measure due to his organizing genius and untiring efforts. By the withdrawal of Mr. Sanders the State of Pennsylvania loses a powerful force that was wholeheartedly devoted to its agricultural progress.

A cotton boll weevil laboratory and field station has been opened at Florence, S. C., under a cooperative project between the Bureau of Entomology and the South Carolina Experiment Station, with Dr. N. E. Winters in charge. Early in May Mr. Coad spent a few days at Florence, conferring with Prof. Barre, Prof. Conradi, and Dr. Winters, relative to the plans for this season's experiments. Messrs. H. C. Young and V. V. Williams of the main Boll Weevil Laboratory at Tallulah, La., have been detailed to the Florence station. In addition, a number of entomologists will be employed. Plans were made to study primarily the particular point of weevil biology and behavior which have local significance in connection with control measures. Extensive tests are planned to include the field use of all of the principal suggested measures of control, such as the dusting method, the Florida method, and the use of sweetened poisons. In addition to the work at Florence, certain of these experiments will be repeated at Clemson College and several other points in the State, representing the principal topographical districts. The experimental work to be conducted at the Boll Weevil Laboratory at Tallulah, La., relative to the use of airplanes for distributing poison dust for the control of the boll weevil is now under way. In April, three De Haviland 4B planes were detailed by the Air Service for use in this work in cooperation with the War Department. These planes are under the command of First Lieut. Guy L. McNeil, who served on this same project last season; Allen L. Morse, an aeronautical engineer from McCook Field, Dayton, Ohio, was also detailed for duty on this project and arrived at Tallulah shortly after the arrival of the planes. It has been found that owing to the different behavior of the DeHaviland planes, as compared with the small Curtis plane used in the experiments conducted last year, the dusting problem becomes quite different, and the mechanical problem of providing suitable distributing mechanism is very complicated. Several types of dust hoppers have been constructed for use in these planes. This phase of the work is still in an experimental stage and it will require considerable time and experimentation before a final design for a hopper can be decided upon. Mr. Coad, who is in charge of the Boll Weevil Laboratory, hopes to have a fairly satisfactory permanent hopper installed in at least one of the planes in time to use it in actual control work during the summer months. Several plantations near the landing field have been mapped and all arrangements made for poisoning the cotton on these in an effort to accomplish boll weevil control through the season.

Apicultural Notes

Mr. Arthur C. Miller, Providence, R. I., an authority on beekeeping, died at his home, June 11, in the 61st year of his age.

Mr. A. P. Sturtevant of the Bureau of Entomology appeared before a board of experts on May 29 to defend his thesis presented for his doctor's degree at the George Washington University at commencement in June. His thesis is entitled: "The Development of American Foulbrood in Relation to the Metabolism of its Causative Organism,"

Mr. Paul E. Smith, Miss Effie Marie Ross and Miss Mary G. Rozelle have been appointed by the Bureau of Entomology as temporary aids for a continuation of the work on the temperature of the bee colony during the active season which was done last year. This year the work will be carried out only during the period of the heavy honey-flow from tulip tree during the month of May, in order to get additional data for this important period.

Because of the present economic conditions in Germany, the Berlin Bieneninstitut is in danger of being entirely discontinued. To prevent this an effort is being made in the United States to raise funds sufficient to insure the continuation of the valuable research work of this institute. Dr. Ludwig Armbruster, Director of the Institute, is also editor of the *Archiv für Bienenkunde*, the only strictly scientific journal devoted to bees and beekeeping, and the aid to the institute will probably insure a continuation of this journal.

Messrs. A. D. Shaftesbury, Bruce Lineburg, and B. Kurrelmeyer of Johns Hopkins University and Prof. L. M. Bertholf of the North Carolina College for Women have been appointed as temporary assistants in the Bureau of Entomology beginning June 1. These men were all at the Bee Culture Laboratory last summer studying special problems for which material is available only in the summer and are returning to continue the same studies. Mr. Lineburg will receive his master's degree in June and his thesis will consist of the results of the work done last summer, the paper being entitled: "Feeding of Honeybee Larvae."

Wisconsin beekeepers will keep "Open House" to the beekeepers of the United States for one week during their fifth annual conference at Madison, Wisconsin, August 13 to 18. The entire conference will be dedicated to Dr. Charles C. Miller, one of the greatest and most beloved of beekeepers. Prof. H. F. Wilson of the Wisconsin College of Agriculture will preside at all meetings. The Charles C. Miller Memorial Apicultural Library, which is now a part of the Wisconsin Agricultural Library, will be dedicated on Friday, August 17. Contributions for this library have been received from many countries so that it is an international monument to the beekeeping industry as well as to Dr. Miller. A pilgrimage by automobile to the former home of Dr. Miller at Marengo, Illinois, will take place on Saturday, August 18. A special service will be held there and a tablet in memory of Dr. Miller placed in the Presbyterian church with which he was connected for many years. All of Dr. Miller's friends are invited to attend the ceremony at Marengo. Four members of the staff of the Bee Culture Laboratory of the Bureau of Entomology will have part in this meeting. Dr. S. B. Fracker, State Entomologist of Wisconsin, is also on the program. Prominent workers in beekeeping from all parts of the United States will speak, and this is expected to be one of the greatest beekeeping conventions ever held. During the week, papers will be given on Habits of Bees; Division of Labor among Bees; Digestion of the Worker Bee; Field Trips made by Individual Bees; Temperature of the Bee Colony in Spring, in Summer, and in Winter; Humidity in the Hive; Instinctive Mechanisms of Bees and Swarming Behavior; Behavior as Influenced by Locality; Bee Disease and Extension Problems.

Horticultural Inspection Notes

Mangoes from Jamaica arriving at Philadelphia and New York during the months of May and June were found by Messrs. Max Kisliuk, Jr., and Emile Kostal to be

infested with larvae of what appeared to be the West Indian Fruit Fly, *Anastrepha fraterculus* Wied.

During the race of a fleet of passenger vessels to land thousand of immigrants at New York on July 1, 1923, many interesting interceptions of contraband plant material were made. The material intercepted included a species of *Colocasia*, green corn, and Irish potatoes.

Mr. L. R. Dorland, who is in charge of the activities of the Federal Horticultural Board at Nogales, Arizona, attended the conference of the Western Plant Quarantine Board at Phoenix, Arizona, during the month of May.

Mr. Lee A. Strong, Chief, Bureau of Plant Quarantines, State Department of Agriculture of California, visited Washington, D. C., during the month of June for the purpose of consultation.

Oranges, taken by Mr. A. C. Fleury, collaborator of the Federal Horticultural Board at San Francisco, Calif., from the baggage of a passenger on a vessel arriving fromJapan, were found to be infected with Citrus Canker.

Prof. R. Kent Beattie, of the Federal Horticultural Board, visited various points in New England during the month of June for the purpose of checking over plants entered under special permit.

Inspector P. E. Lewis, of the California State Department of Agriculture, on May 22 collected larvae of the Mediterranean Frui Fly, *Ceratitis capitata* Wied., in rose apple (*Eugenia jambos*) which arrived in San Francisco from Hawaii.

Mr. E. R. Sasscer, of the Plant Quarantine Inspection Service, Federal Horticultural Board, visited various maritime and Mexican border ports during the month of July for the purpose of consulting customs officials and representatives of the Board.

The Avocado Weevil, *Heilipus lauri* Boh., was taken by Messrs. R. B. Haller and M. M. Richardson in avocadoes for sale in Piedras Negras, Mexico, during the month of June. This same insect was also found by Mr. O. D. Deputy in avocadoes for sale in a Matamoros market.

An interesting chestnut weevil, *Balaninus* sp. was collected by Mr. H. Y. Gouldman at the Inspection House, Washington, D. C., the nuts coming from Yunnan, China. Apparently this weevil differs from that which attacks chestnuts in the United States.

Mr. R. D. Kennedy, plant quarantine inspector with the Federal Horticultural Board, who for the past two years has been stationed in Washington, D. C., was transferred on July first to New York City to assist in the plant quarantine inspection work at that port.

Orchids (*Aerides Lawrenceanum* and *Vanda Sanderiana*) introduced under special permit from the Philippine Islands recently arrived in Washington, D. C., infested with what appears to be a new species of *Chionaspis*. Mr. W. B. Wood, who in) spected the material, also found the plants infested with *Parlatoria proteus* (Curtis- and mealy bugs, *Pseudococcus* sp. closely related to *P. citri* (Risso) and *P. lilacinus* (Ckll).

Mr. L. C. Griffith, of New York, visited Boston during the month of June for the purpose of assisting Mr. R. I. Smith in the testing of the new sterilization plant installed in Charleston by the Terminal Wharf and Railroad Warehouse Company.

The cylinder, which has been approved, is 50 feet long and 9 feet in diameter, and may be used either for fumigation or sterilization work.

The cotton fumigation plant operated by the California Cotton Mills Company and formerly located at Seattle, Washington, has been moved from that city to San Francisco, Calif. This leaves but one cotton vacuum fumigation plant in Seattle. The fumigation plant operated by this same company at Oakland, Calif., has been equipped for sterilization work, and the entry of broom corn is now permitted at that port.

Fumigation facilities now being available at Portland, Ore., this port has been opened for the entry of baled cotton. The fumigation plant was constructed by Mr. Harry Leckenby, and the cylinder of the fumigatorium is 67 feet long and 6½ feet in diameter. It is conveniently located on the docks, avoiding the necessity of a long haul after the cargo has been discharged.

Green chickpeas in the pod were found by Mr. Emile Kostal, of New York, to be infested with the following insects: *Heliothis virescens* Fab. in peas from Porto Rico, Jamaica, and Barbadoes; *Etiella zinkenella* Trist. in peas from Porto Rico; and *Ancylostomia stercorea* Zeller in peas from Jamaica and Trinidad.

Prof. David Lumsden visited various points in the state of New York during the latter part of June examining plants imported under special permit. While at Rochester he collected in Highland Park adults of the Oblong Leaf Weevil, *Phyllobius oblongus* Linn., feeding on elm. Apparently this is the first record of the occurrence of this common European insect in the United States. An immediate investigation of the Rochester infestation will be made.

Mr. A. C. Fleury reports that through the vigilance of one of the inspectors of the State Department of Agriculture of California there was intercepted at San Francisco in the baggage of a passenger arriving at that port from Honolulu, H. T., several cotton bolls containing cotton seed which upon examination were found to be infested with living larvae of the Pink Bollworm, *Pectinophora gossypiella* Saund. The owner of the cotton bolls claimed that she had received them from the Manchester New Hampshire Cotton Mills, and that they had been sent to her for the purpose of teaching textiles.

Inspectors of the Federal Horticultural Board stationed on the Mexican Border have found mangoes from the interior of Mexico during the months of May and June to be infested with the Mexican Fruit Fly, *Anastrepha ludens* Lw. These larvae were taken at Matamoros, Nuevo Laredo, Piedras Negras, and Juarez. It was difficult to determine definitely the origin of the fruit, although some of it was reported to have come from the state of Jalisco. An inspector of the California State Department of Agriculture also intercepted this insect in mangoes found in the ship's stores of a vessel arriving at San Pedro from Mexico.

The following interesting interceptions have been made by inspectors of the Florida State Plant Board:

Coccus viridis (Green), the green scale, was intercepted from Nassau in three different shipments. Nine shipments from the Bahama Islands showed an infestation of *Pseudaonidia articulatus* (Morg.) and *Aspidiotus destructor* Sign. was taken on three occasions on cocoanuts and four times on bananas from Cuba. Yams from Cuba and Grand Cayman were infested with *Targionia hartii* (Ckll.).

Mr. U. C. Zeluff, stationed at Tampa, Florida, collected oranges on a ship from Tampico, Mexico, infested with the Mexican Fruit Fly, *Anastrepha ludens* Lw.

Mexican-grown Irish potatoes used as ship's stores have during the past three years been found to contain larvae of an injurious weevil. In April of the present year, Mr. Clyde P. Trotter, inspector of the Federal Horticultural Board stationed at Galveston, Texas, collected additional larvae of this weevil and in this instance adults were reared by Mr. L. L. Spessard and identified by Dr. E. A. Schwarz, of the National Museum, as *Epicaerus cognatus* Sharp. This weevil is not known to occur in the United States and all inspectors engaged in port inspection work should carefully examine potatoes for this pest. Infested potatoes are usually found during the spring months. Thus far it has been impossible to determine definitely the exact origin of the potatoes, although they are usually taken on board at Vera Cruz, Mexico.

Mr. H. B. Shaw, in charge of the work of the Federal Horticultural Board at New York City, reports the following incident as demonstrating the necessity for close supervision of prohibited plant products brought to a port of the United States en-route to a foreign country:

845 sacks of cotton seed infested with larvae of the Pink Bollworm, *Pectinophora gossypiella* Saund., recently arrived at New York from Porto Rico for trans-shipment to England. The presence of the Pink Bollworm in the cotton seed not only necessitated the cleaning of the hold of the vessel which brought the cotton seed to New York, but also the cleaning of the lighter and the pier over which the cotton was trucked. It was also necessary to issue written instructions to the steamship company to have the hold of the vessel carrying the seed to England cleaned on its arrival at Southampton.

Mr. J. W. O'Brien, a plant quarantine inspector of the Federal Horticultural Board located in New York City, in cooperation with the customs officials, recently intercepted living larvae of the European Corn Borer in stalks of broom corn contained in passenger's baggage. This material was taken from the baggage of a third class passenger arriving from Italy, who proposed to take it to Missouri. Subsequent to this interception, Mr. O'Brien discovered a similar collection in the baggage of a passenger arriving from Germany.

Notes on Medical Entomology

Dr. F. C. Cook of the Insecticide and Fungicide Board, U. S. Dept. of Agriculture, died on June 19 at Dallas, Texas, following an operation for appendicitis. Dr. Cook had been in Dallas nearly a month working with the agents of the Bureau of Entomology on the chemotropic responses of various flies.

Mr. R. W. Wells, who has been engaged for several years in the Bureau of Entomology working on insects affecting live stock, resigned during July to enter commercial work.

On June 27 a conference was held at Del Rio, Texas, in connection with a meeting of the Sheep and Goat Raisers Association of Texas to consider ways and means of carrying out further experiments with scab mites, particularly along biological lines. At this conference the Texas Experiment Station was represented by Director Youngblood and Professor Jones, the experiment sub-station at Sonora, Texas by Dr.

Bennett and Mr. Peters, the State Livestock Sanitary Commission by Mr. Boog-Scott and Mr. Rasco, and the Bureau of Entomology by Messrs. Laake and Babcock.

According to Dr. F. C. Bishopp, on June 23 five cases of dengue fever had been reported to the health department in Dallas, Texas. The first of these occurred about the middle of the month. A number of cases of dengue have also been reported from Denton, Texas. Yellow fever mosquitoes are already fairly numerous and it is possible that the disease may again assume epidemic form.

After spending several months in Baltimore, Dr. W. V. King of the Bureau of Entomology has returned to Mound, La., and resumed active charge of the Malaria Mosquito Laboratory at that place. While in Baltimore, Dr. King cooperated with Johns Hopkins University, working up a vast number of statistical data relating to notes on malaria mosquitoes collected at Mound.

According to *Science*, Dr. George E. Beyer, Entomologist of the State Board of Health, New Orleans, La., formerly adjunct professor in biology, Tulane University School of Medicine, has been requested to aid in stamping out malaria in San Domingo, and has been granted a leave of absence for that purpose.

Pacific Slope Notes

Mr. H. E. Burke, Bureau of Entomology, completed the requirements for the Ph.D. degree at Leland Stanford Junior University in June. Mr. Burke's major is entomology, with work on the Pacific flathead borer, and his minor is physiology, with work on The Taxic Responses of the Lead-Cable Borer.

Mr. R. E. Campbell, Bureau of Entomology, reports successful results in the control of the pea aphis on cannery peas in southern California, as the result of extensive experiments undertaken in the vicinity of San Jose. The experiments indicate that sufficiently inexpensive control measures will be worked out in the near future.

Prof. H. J. Quayle, professor of entomology in the Citrus Experiment Station and Graduate School of Tropical Agriculture of the University of California, has been granted a period of sabbatical leave for six to twelve months, during which time he will visit Australia to study fumigation problems, assist growers in fumigation methods, and conduct trials of materials in continuation of experiments begun in California, thus securing data in advance of the next fumigating season in California.

Adult dried fruit beetles, *Carpophilus hemipterus* Linn., have been found by G. H. Vansell feeding on freshly cut Cheddar cheese in the storage room of the Creamery at the University Farm, Davis, California. It is supposed that the beetles flew in at the unscreened open ventilators which are only a few feet from a row of fig trees. The dried fruit beetle is frequently found on the partially dried fig in California and in the absence of fruit during the spring months they have apparently turned to the cheese for food.

On June 2, the Department of Entomology of the University of California and the staff of the Museum of the California Academy of Sciences gave at the Hotel Stewart, San Francisco, a complimentary dinner to Professor and Mrs. T. D. A. Cockerell, who were passing through San Francisco on their way to Siberia in quest of fossil insects. Thirty-six were at the table, including many of the biological workers of

the bay region of California. Dr. Barton W. Evermann acted as toastmaster, and all present joined in wishing their guests a pleasant voyage.

The Modesto, Calif., Chamber of Commerce appointed a committee to interview the Board of Supervisors regarding the seriousness of the bean weevil situation in Stanislaus County. Following a conference with the Farm Center Directors, the Chamber of Commerce extended to A. O. Larson, of the Bean Weevil Investigations at Alhambra, an invitation to visit the county and discuss the bean weevil situation at different places, with the view to securing widespread interest in better control methods for this pest. Mr. Larson's work has been highly commended by Lester F. Baker, Chairman of the Bean Weevil Committee of the Modesto Chamber of Commerce.

North Eastern Summer Field Meeting

The summer field meeting of the entomologists of the north-eastern United States, was held in Connecticut July 26 and 27, the trips from one point to another being made by automobile. The members gathered on the afternoon and evening of July 25, at New Haven where they spent the night, Hotel Taft being the headquarters. The next morning they visited the entomological department of the Agricultural Experiment Station, New Haven, the Station farm at Mount Carmel, West Rock Park, Yale bowl, Harkness Memorial Quadrangle, and the orchard of F. N. Platt, Milford, where spraying and dusting experiments are being conducted. From this point the party proceeded along the coast to the State Park at Hammonasset Beach, Madison. Following the luncheon, there was a base ball game (Worthley, umpire); some of the entomologists went bathing while others collected insects along the beach. Late in the afternoon, the party went northward passing Wesleyan University at Middletown, stopping at the large greenhouse and nursery establishment of the A. N. Pierson Co., Cromwell, viewed the gigantic elm tree in Wethersfield, and then to Hartford, where at the Hotel Bond a dinner and evening meeting had been arranged.

An interesting lecture on the Japanese beetle, illustrated by lantern slides, was given by Mr. Loren B. Smith of Riverton, N. J., in place Mr. C. H. Hadley, who could not be present. Friday morning the party drove through Keney Park to the tobacco sub-station at Windsor, and visited the forest experimental plots at Rainbow, returning via Elizabeth Park, to Hartford, where luncheon was served in the State Capitol. After luncheon the visitors were shown about the Capitol and the State Library, then drove via Rockville, to the Connecticut Agricultural College at Storrs. Here a demonstration of high-power spraying of woodland and orchard trees was given by the gipsy moth forces. After supper there was a base ball game between the Connecticut gipsy moth men and a team picked from the visitors (Burgess, umpire). In the evening motion pictures were shown in the armory, including those on the European corn borer, and the gipsy moth, prepared by the U. S. Department of Agriculture.

Officers elected for next year are; Chairman, H. E. Hodgkiss; Secretary, C. H. Hadley. The members expressed a desire to hold the next field meeting in the vicinity of Philadelphia in 1924.

The following were present; H. A. Ames, Somerville, N. J.; J. T. Ashworth, Danielson, Conn.; E. A. Back, Washington, D. C.; D. N. Borodin, New York, N. Y.

H. L. Blaisdell, Melrose,Mass.; R. C. Botsford, New Haven, Conn.; W. E. Britton, New Haven, Conn.; F. E. Brooks, Washington, D. C.; A. F. Burgess, Melrose Highlands, Mass.; C. W. Collins, Melrose Highlands, Mass.; C. R. Crosby, Ithaca, N. Y.; S. M. Dohanian, Somerville, Mass.; E. P. Felt, Albany, N. Y.; Philip Garman, New Haven, Conn.; Hugh Glasgow, Geneva, N. Y.; F. W. Graves, Melrose Highlands, Mass.; Melvin Guptill, Sudbury, Mass.; T. L. Guyton, Harrisburg, Pa.; E. A. Hartley, Melrose Highlands, Mass.; G. W. Herrick, Ithaca, N. Y.; T. J. Headlee, New Brunswick, N. J.; H. E. Hodgkiss, State College, Pa.; C. E. Hood, Melrose Highlands, Mass.; J. L. Horsfall, Bustleton, Pa.; J. F. Jamieson, Riverton, N. J.; R. W. Kelley, New York, N. Y.; G. H. Lamson, Storrs, Conn.; F. H. Lathrop, Highland, N. Y.; M. D. Leonard, Albany, N. Y.; Q. S. Lowry, Boston, Mass.; J. A. Manter, Storrs, Conn.; C. W. Minott, Melrose Highlands, Mass.; F. H. Mosher, Melrose Highlands, Mass.; H. L. McIntyre, Albany, N. Y.; A. H. Parkins, Boston, Mass.; Alvah Peterson, New Brunswick, N. J.; D. M. Rogers, Boston, Mass.; J. V. Schaffner, Melrose Highlands, Mass.; A. F. Schulze, Storrs, Conn.; R. A. Sheals, Providence, R. I.; L. B. Smith, Riverton, N. J.; A. E. Stene, Kingston, R. I.; E. M. Stoddard, New Haven, Conn.; B. H. Walden, New Haven, Conn.; W. R. Walton,Washington, D. C.; H. I. Winchester, Melrose, Mass.; R. Wooldridge, Melrose Highlands, Mass.; L. H. Worthley, Arlington, Mass., and M. P. Zappe, New Haven, Conn.

W. E B.

Bee Disease in California. For several years bees in California have been suffering from a malady apparently coincident in time with the blossoming of the California buckeye, *Aesculus californica*. Beekeepers generally are blaming buckeye for the trouble. The condition is spoken of as "buckeye poisoning." The malady kills the field bees first, then the brood is affected. Much brood evidently dies and is pulled from the cells. The young emerging bees are badly deformed and unable to fly. Finally the bees try to supersede the old queen. The resultant young queen is worthless, seldom ever getting mated. Thousands of colonies are lost annually.

Investigational work has been started by the University of California to definitely determine the cause. It is hoped that a remedy will be found.

G. H. Vansell

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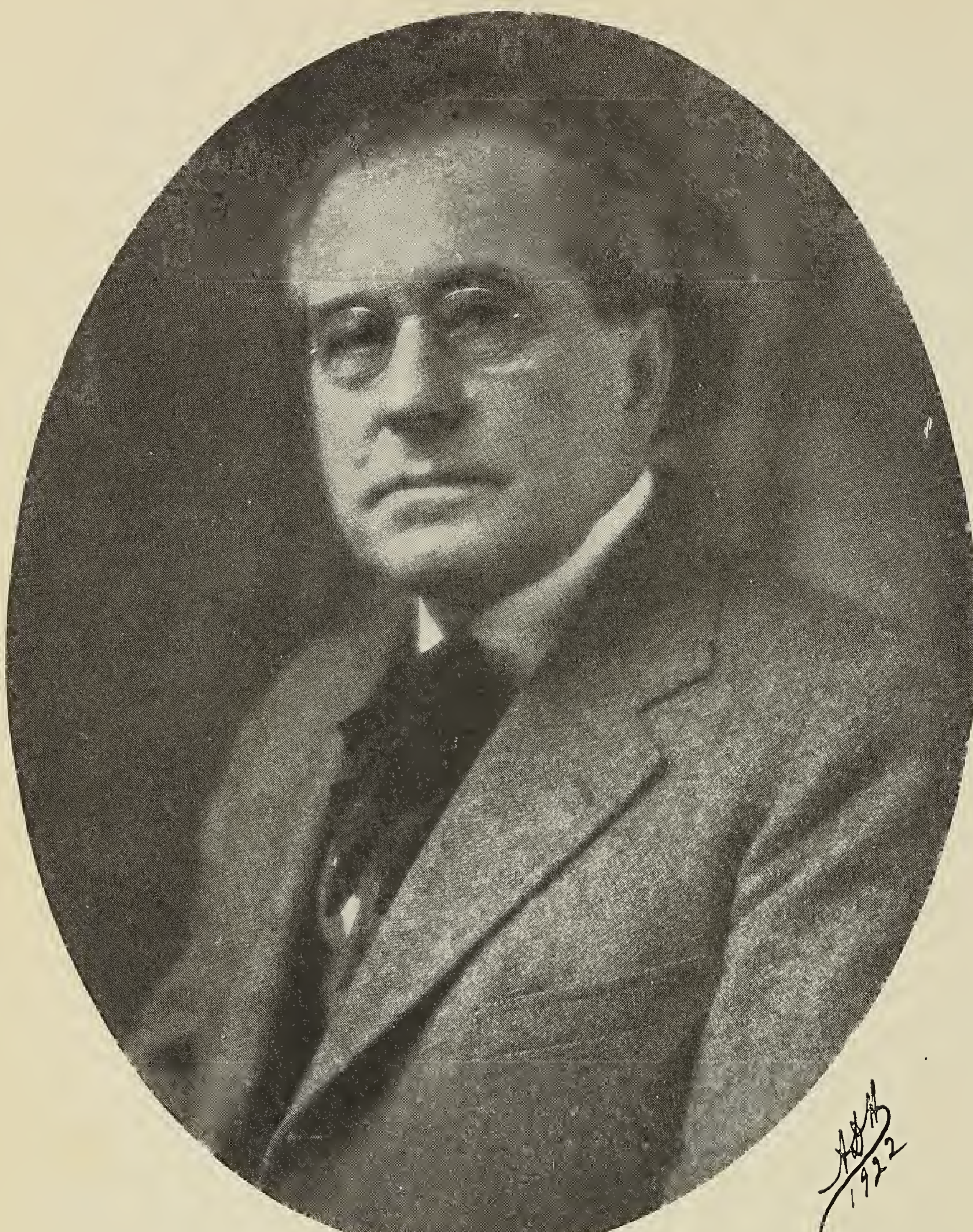

A D Hopkins

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THE PROGRESS OF FOREST ENTOMOLOGY IN THE UNITED STATES[1]

Abstract

A biographical sketch of Dr. A. D. Hopkins, the father of forest entomology in this country, whose studies established the great economic importance of forest insects, the percentage principle of control, the host selection principle, some of the possibilities in silvicultural control and business management and the value of the Bioclimatic Law as a guide in control work. The application of these investigations is exemplified by the studies of assistants to Dr. Hopkins, W. F. Fiske on the gipsy moth, Dr. F. C. Craighead on the locust borer, and Dr. T. E. Snyder on white ants. There is great need for further investigations along these lines and for the closest cooperation between forester and forest entomologists in developing silvicultural methods and modifications in mangement.

On July 12, 1923, Dr. A. D. Hopkins who has been in charge of forest insect investigations of the Bureau since July 1902 was, in accordance with his expressed wishes, transferred from his former duties to that of special research in bioclimatics.

Dr. Hopkins enters a field extremely important and interesting, relatively new and with a wide and direct entomological bearing. He leaves behind a science of which, in its application to American types of forests, he has been the father and pioneer. It is fitting and proper at this time to give a brief biographical sketch of Dr. Hopkins, to summarize briefly his great achievements in Forest Entomology and to outline the most notable contributions.

Biographical. Dr. Hopkins was born August 20, 1857, on a farm at Evans, near Ripley, Jackson Co., West Virginia. From his earliest recollection he was interested in and made collections of, first, land shells and, in succession, water shells, bird eggs, birds, and finally insects, and has, since he was about 12 years old to the present time, specialized on insects. Some work he did on the farm with an insect affecting raspberries, including original drawings to illustrate the insect, its work and

[1]A contribution by members of the Division of Forest Entomology of the Bureau of Entomology, U. S. Department of Agriculture.

its parasites, led to his appointment in 1890 to a position on the staff of the West Virginia University Agricultural Experiment Station.

His love of and indefatigable efforts to understand nature had by this time equipped him in extraordinary fashion for the life he was to follow. As State Entomologist Dr. Hopkins immediately gave evidence of his insight into the entomological problems of the forest and his deep interest in them. He showed the broad knowledge of entomology that leads to a recognition of the value of systematic and biological investigations in their application to economic entomology, building up a collection and a reputation for keenness of vision in the warfare between insects and man. Surely the recognition of forest entomology as a branch of science developed as his accomplishments increased.

In the autumn of 1892 he was sent on a misssion to Germany to find a beetle that would be predaceous on the barkbeetle (*Dendroctonus frontalis* Zimm.) that was killing the pine and spruce timber of West Virginia and adjoining states. The mission, as to the attainment of the object of finding the beetle (*Clerus formicarius* Linn.) was a success as described in Bulletin 56, West Virginia Agricultural Experiment Station, 1899. In recognition of this the Board of Regents of the West Virginia University honored him with a degree of Doctor of Philosophy.

In 1899 he was employed by the U. S. Division of Entomology (now Bureau) to make entomological explorations in the Pacific Coast and Northern Rocky Mountain forests; in 1900 to make a similar exploration in the spruce forests of Maine; and in 1901 to make a special investigation of depredations by tree-killing insects in the Black Hills of South Dakota. In recognition of services on these special missions, and as foremost forest entomologist in America, Dr. Hopkins was, on July 1, 1902, appointed Chief of Forest Insect Investigations in the Bureau of Entomology, which position he has held to the present time.

Dr. Hopkins' first activities as Forest Entomologist consisted of extensive preliminary surveys of the character and extent of the most important depredations by forest insects throughout the country. The results of these surveys and additional studies convinced him of the primary necessity for studies of the Scolytid barkbeetles, especially those in the genus *Dendroctonus*, many species of which he found to be new and the most destructive enemies of coniferous forests in this country.

Since about 1895 Dr. Hopkins has been interested in broad biological questions and in 1900 announced the recognition of a natural law. Of late years he has devoted much time to the development of this law

which is now known as the Bioclimatic Law, a law of life and climate as related to geographical distribution of plants and animals, life and climate zones, etc. To this work Dr. Hopkins expects to devote the rest of his life.

As to his school education, Dr. Hopkins has often regretted that it was limited to the common schools of his native county but for 57 years he has been a student and investigator with nature as his teacher and feels that, although yet a student, he has gained knowledge and experience equaled by few college graduates.

Forest Entomology in America. Forest entomology in the United States was relatively new. Intensive investigation of forest insects being only about a quarter of a century old and so different from the forest entomology in Europe, not only in the types of insects involved but also in the environmental conditions which govern the forests, an almost entirely new problem was to be solved. Furthermore, the value of forest and forest products, as compared with other agricultural crops, was still too small a proportion of our national resources and income for it to receive its full share of support, although our forests, by virtue of their just right, are demanding an ever increasing amount of attention and concern. Nevertheless, in spite of this comparatively short period of research and relatively poor support, much has been done by forest entomologists under the lead of Dr. Hopkins in this country and it is only fitting that what has been accomplished should be recognized in this country as abroad. During the past twelve years many of the British colonial forest entomologists have visited the United States Bureau of Entomology to study methods of combating forest insects.

The destructiveness of forest insects in the United States was early realized by Dr. Hopkins and other forest entomologists and foresters. However, it was found difficult to overcome the popular opinion that barkbeetles were secondary in attack as in Europe and to educate people into realizing their serious primary nature. In the United States certain barkbeetles (species of *Dendroctonus*) are absolutely primary and concentrate on the largest and best timber. They cannot be combated in the same manner as can insects that attack only weakened trees. But Dr. Hopkins was of the opinion from the first that forest insects could be controlled!

The investigators of forest insects in the United States have been considerably retarded in their efforts and progress by lack of financial support. The appropriations for forest insect control have never been equal to those for the control of insects injurious to other crops. Leav-

ing aside appropriations by the states, $30,000 per year has been the average annual appropriation for the Division of Forest Insects of the Federal Bureau of Entomology and this, despite the fact that forest insects undoubtedly kill more merchantable timber in coniferous forests than does fire, for the control of which there are large annual appropriations by federal, state and private timber owners.

Despite this shortage of funds, Dr. Hopkins and his assistants have given due attention to those phases of the subject which have been deemed most important, such as tree-killing barkbeetles and insects injurious to forest products, where there was most need and demand by owners for control methods.

In addition, very complete biological investigations of the principal forest insects of the United States have been made by forest entomologists of the federal and state governments and effective methods of control have been determined for many of the most injurious species.

Foremost, among the many notable contributions made by Dr. Hopkins to the science of forest entomology are the following broad principles regarding the work of combating forest insects in America:

Economic Principles of Forest Entomology

First, *artificial methods* of controlling destructive barkbeetles which include, (a) *the percentage principle of control* by which it is only necessary that enough of the depredating insects be destroyed to turn the balance in favor of their natural enemies; and (b) *the host selection principle* by which it is possible to control an insect attacking a valuable host tree without reference to those in a less valuable host, due to the adaptation of the insect to the host upon which it has fed for many years and the subsequent confinement of its attack to that host.

Second, *silvicultural control and business management*, which will provide for the care of standing timber and the handling of crude and finished products in such a manner as to bring about unfavorable conditions for attack by the more destructive insects. This includes the use of pure stands to prevent the attacks of certain defoliators and mixed stands in other cases; the removal of slash only where logging operations are sporadic or of short duration; and in the case of timber products the utilization of natural elements such as solar heat and water.

Third, the *Bioclimatic Law* as a guide to (a) the proper dates and periods to apply a remedy in any given locality, (b) determine the natural distribution of an insect and (c) the sections of a state or country where artificial distribution from another country or an infested section in this country would be most *dangerous* as related to a destructive insect or most *useful* as related to a beneficial one.

These principles which embody in part silvicultural and forest management practices are being tried out on a large scale and if, after sufficient test, they prove true, they are the most important and economical principles ever advocated. Without such principles in certain inacces-

sible areas of the country, control work against forest insects could never be undertaken.

Artificial control embodying these principles has been carried on extensively both in the east and in our western forests and has resulted in the saving of millions of feet of standing commercial timber from destruction by insects. The control projects which have been instituted on these principles by the Forest Service, Park and Indian Services, state and private owners are too numerous to mention but the success of the methods has been well established.

Removal of 50% to 75% of the infested timber brings about a reduction in the loss of from 60% to 80% in the first year and, as has been recently demonstrated in Southern Oregon and Northern California on the largest project yet undertaken, at a cost which leaves a profit at the end of the first year's work.

On a project in Northeastern Oregon from 1910 to 1913, as a result of extensive and intensive investigations, Dr. Hopkins was able to prove that a case of long standing epidemic infestation of *Dendroctonus monticolae* Hopk. in inferior species of timber such as lodgepole pine will *not* migrate to any extent to another and more valuable host such as yellow pine, although the stands are adjacent and intermingled. This is extremely valuable data since control work in lodgepole pine, especially in inaccessible areas, is often impractical.

Contributions by Assistants of Dr. A. D. Hopkins

Along the line of silvicultural control much important work has already been done. W. F. Fiske, a former assistant of Dr. Hopkins, in 1913, after a study of the favorable food plants of the gipsy moth, advocated pure stands of trees which were unfavorable to the gipsy moth larvae, or in association with less favored food plants. He also found that mixed stands of oak and white pine were only slightly less susceptible to serious damage than pure stands of oak which is the favorite food plant. This was the real beginning of silvicultural control work in this country, although it has long been known to foresters and forest entomologists that, in general, pure stands are more susceptible to their particular enemies than mixed stands. The main difficulties to be encountered in practices embodying pure stands or mixed stands are to be found in the fact that, while a pure stand of one forest tree will be practically immune to the insect for which one recommendation is made, it offers in its turn an exceptional opportunity for wholesale loss from another insect. Hence, it can be readily seen that studies over many years must be made before positive instructions regarding silvicultural

practices from the entomological viewpoint will be available. Indeed, with only a short period of study—some twenty-five years—no more positive results can be expected if they are to be considered as authoritative.

There is no doubt but what similar studies to those made by Dr. F. C. Craighead, a former specialist on forest entomology under Dr. Hopkins, and his successor as Forest Entomologist, on the locust borer could be done with other forest insects, even though it is not yet entirely proven to the satisfaction of foresters and entomologists that this method is entirely effective in the case of the locust borer. Much more work should be done with the locust borer to thoroughly prove that shading the trunks will prevent attack by sunlight-loving beetles.

Notable host plant studies were made by Craighead, and J. M. Miller has made valuable contributions to our knowledge of forest-tree-seed destroying insects.

Along other lines studies have been made by Dr. Hopkins and members of his staff on the periodicity of attack by barkbeetles, endemic and epidemic conditions, distances of flight, slash disposal, solar heat control, etc., and much valuable data accumulated.

Methods for the control of insects injurious to both crude and finished forest products have been determined. Special treatments, such as chemical wood preservatives, sprays, and determination of effective kiln drying temperatures, etc., have been developed by Dr. T. E. Snyder and are in effective use, even to the extent of enabling American manufacturers to compete with foreigners for trade in the Tropics with chemically treated, "white-ant-proof" furniture, etc. Snyder discovered that Lyctus powder post beetles lay their eggs in the pores of wood. By closing these pores by the use of any ordinary filler, attack by these insects can be prevented.

The most important and economical methods, however, are those first recommended by Dr. Hopkins, i. e. of management. With a knowledge of the biology of the insects, it has been possible to slightly change the methods of handling timber so as to create unfavorable conditions for attack by insects. By simple methods of classification of stock in piling, periodical inspection, and utilization of the older stock first, injury to seasoned hardwood lumber and products by *Lyctus* powder post beetles can be and is being prevented, resulting in the saving of enormous stores of hardwood for the Army and Navy.

Certain termites require moisture—shut off from the ground, their source of moisture, by proper construction they will dry up. The

natural forces can be utilized and by rapid transportation of green saw logs from the woods into the water at the mill pond or to sites in full sunlight, as worked out by Dr. Craighead and other members of the division of Forest Insects, damage by borers and ambrosia beetles can be prevented. Green lumber can be protected from attack by the removal of bark edges and loose piling.

Future Needs

While Dr. Hopkins and his staff of forest entomologists have chiefly concerned themselves with what have been deemed the most important and most pressing demands from timber holders for information on the insect enemies of forests, tree-killing barkbeetles that take a large annual toll in healthy merchantable timber, and insects infesting forest products where handling has increased the value of the material; it is true that there exist many problems of comparatively lesser importance which still remain to be solved. Among the most important of these are the defoliators. However, it is also true that this type of insect forms the most fluctuating and least constant menace. The caterpillars and false caterpillars responsible for those sporadic losses which are admittedly great are still not truly constant primary enemies of the great bulk of our timber. Death of the defoliated trees is sometimes due to secondary attack. As a consequence, the defoliators have, for economic reasons, had to yield to the continuous pressure of their more dangerous and destructive rivals.

Close cooperation between foresters and forest entomologists in the study of the possibility of silvicultural and management methods of control of these defoliating insects—as has been begun in Canada—will yield valuable results.

Summary

Dr. Hopkins has contributed to the progress of the science of Forest Entomology in at least three distinct ways: He has advanced to a remarkable extent our knowledge of tree-killing beetles as systematist, biologist and morphologist on Scolytid beetles of the world, on which he is recognized as a world authority; established principles of fundamental importance for the economic control of forest insects; organized, led and developed an extraordinary staff of assistants and specialists in the various fields of Forest Entomology. Indeed in the latter connection, while he himself leaves this field the work in which he has so aided, there remain many workers, who, guided and inspired by him, have added much to the knowledge of the problems of Forest Entomology. We may look

to these co-workers, many of whom have not been mentioned and due credit given in this brief account, to continue the work on forest insects so well begun by Dr. Hopkins and we hope that in his newer field Dr. Hopkins will meet with the same success that attended his efforts in Forest Entomology!

THOS. E. SNYDER, *Entomologist.*
WILLIAM MIDDLETON *Assistant Entomologist.*
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Washington, D. C., August 28, 1923.

SEASONAL ADAPTATION OF A NORTHERN HEMISPHERE INSECT TO THE SOUTHERN HEMISPHERE

By JOHN C. HAMLIN, *Officer-in-Charge Prickly-pear Investigations, Commonwealth Prickly-pear Board*

ABSTRACT

Melitara junctolineella Hulst (Order Lepidoptera, Family Pyralidae), one of the several insects introduced into Australia in connection with the attempt biologically to control the prickly-pear pest, is indigenous to North America. In southern Texas it produces two generations annually. Its brood adjustment to seasons was upset by departure from our winter and immediate entry into the summer of the Southern Hemisphere. During the period it has been accomplishing its swing-over to the opposite seasons of Australia three generations have been produced in sixteen months. Complete adjustment to the Australian seasons has not yet obtained but observations indicate that in its ultimate adaptation to the opposite seasons it will have three broods yearly.

On the one hand it is common knowledge that certain species of insects have more or less broods per year as the summer is longer or shorter. On the contrary there is evidence to show that certain species cease activities at certain periods regardless of the conditions of temperature and moisture to which they may be subjected. These instances, however, apply to insects living on the one or the other side of the equator.

When first entering upon duty for the Australian Commonwealth Government, I made many conjectures as to the manner in which certain species from the Northern Hemisphere would adjust themselves to the opposite seasons of the Southern Hemisphere; that is to say where summer is simultaneous with our winter. This adjustment has been kept in mind, and at the present time it is possible to present preliminary data on a yet unsettled adaptation.

The species in point is *Melitara junctolineella* Hulst,[1] an insect indigenous to North America. The larvae feed within the thick joints

[1]Order *Lepidoptera*, Family *Pyralidae*.

of the western prickly-pears, causing large swellings. When full-grown they leave the joints and spin their cocoons beneath fallen segments or other rubbish near the base of the prickly-pear plant. The large sluggish moths which issue from the cocoons mate quickly, deposit eggs as "sticks" and soon die.

During May and June, 1921, stocks of larvae were collected in the vicinity of Uvalde, Texas. The progeny of these insects are still on hand partly in Australia and partly in Texas. Of course, moths emerging from later collected material were mingled with the original lot, but this fact does not affect the developments to be pointed out.

Below is shown the record of the generations of this material from May, 1921 to May, 1923.

RECORD OF GENERATIONS

Year	Month	At Uvalde, Texas, U. S. A.	At Brisbane, Australia.
	May	Emergence	
		Oviposition	
	June		
	July	Larval	On Dec. 6, 1921 a portion of
			the insects left the U. S. A.
	Aug.	Larval	and arrived Brisbane, Aus-
1921		Pupation	tralia on Dec. 30, 1921.
	Sept.	Emergence	Further happenings to this
		Oviposition	portion are shown below.
	Oct.		
	Nov.	Larval	
	Dec.	Larval	Pupated en route
	Jan.	Larval	Emergence
			Oviposition
	Feb.	Larval	Larval
	Mar.	Larval	Larval
	Apr.	Pupation	Pupation
	May	Emergence	Emergence
		Oviposition	Oviposition
	June		Larval
1922			
	July	Larval	Larval
	Aug.	Larval	Larval
		Pupation	
	Sept.	Emergence	Larval
	Oct.	Oviposition	Larval
			Pupation
	Nov.	Larval	Emergence
			Oviposition
	Dec.	Larval	Larval
	Jan.	Larval	Larval
	Feb.	Larval	Larval
1923	Mar.	Larval	Pupation beginning
	Apr.	Pupation	Emergence & oviposition beginning.
		Emergence	
	May	Oviposition	Pupation ending

From the above record of the seasonal history of the species, it will be noted that at Uvalde there are two generations annually. The over-

wintering larvae emerge from late April to early July, reaching the maximum emergence during May or June depending upon the weather conditions. The summer brood develops in a relatively short period and the fall appearance of adults occurs from late August to early November, usually attaining the peak of emergence about the first of October. The progeny of these fall moths pass the winter in the larval condition. Thus, the summer generation requires four months from egg to adult, while the winter brood takes eight months.

Now, a portion of this material was packed with cactus in properly lighted and ventilated cases and shipped via San Francisco, Honolulu, Pago Pago and Sydney to Brisbane, Queensland. The shipment left San Francisco on December 6, 1921 and reached Brisbane at the end of that month. Enroute the cases were placed on the bridge deck of the S. S. Sonoma beneath a canvas canopy which was removed in the early morning each day to allow the sunlight to enter the cases.

The larvae were just one month from the egg on the date of departure from San Francisco. They were of the winter brood which would normally spend about six months in the larval stage.

This shipment of material was opened in the laboratory at Sherwood (near Brisbane), Queensland on January 5, 1922. Practically all of the larvae were found to have pupated enroute, and on January 7, 1922 the first adults issued from the cocoons. Emergence ended on February 1, 1922. Thus, the passage through and into summer weather in the tropics and in the Southern Hemisphere greatly accelerated the development of these winter brood larvae.

It will be noticed, then, that the (now) Australian portion emerged and oviposited in January, 1922, fully five months prior to the emergence and oviposition dates recorded for that portion of material which remained in the native habitat of the species.

Again, the progeny of this first Australian generation completed another cycle about May 18, 1922. Thus, two generations of the Australian material completed their cycles slightly before the normal spring emergence at Uvalde of the portion which remained at home.

The third generation of the Australian portion began about the proper time for the larvae to get started just before the advent of the winter season in Southern Queensland. The emergence of adults of this brood was rather drawn out, probably having been influenced by the upsetting of the normal development of the two previous generations. The adults issued from October 31, 1922 to January 2, 1923.

The fourth generation of the Australian lot numbered several thousand, and emergence of the adults began on April 13, 1923. On May 18, 1923 pupation of this brood was practically completed, so it may be judged that the maximum emergence period would be about the middle of May, 1923.

The fifth generation of the Australian batch may, then, be considered to date from May 15, 1923.

Thus, during the period when the species was accomplishing its swing-over from the seasons of the Northern Hemisphere to those of the Southern Hemisphere, there were produced three generations in sixteen months.

The rapidity of development of the species duiing midsummer (January-February) in 1923 is shown by the notes on certain cages of the fourth generation material. These cages received freshly deposited eggs about the first of January, 1923 and the adults issued therefrom within three months.

From the reactions to the Australian seasons so far observed it seems that in the ultimate adjustment to seasons, *Melitara junctolineella* will have three generations annually instead of the two which occur in Southwest Texas.

The manner in which such adjustment will beworked out may be seen in the transition period above reviewed. Those portions of a given brood which appear at unfavorable intervals are eliminated, and only that part of the brood which happens to appear at the opportune time will be preserved. Such elimination and preservation should, after a number of generations, accomplish a thorough adjustment of the brood cycle to the seasonal cycle in the new environment.

The observed rapidity of development and the long summer of Queensland strongly indicate that the final adaptation of this species to that environment will be three broods yearly.

The over-wintering generation will probably emerge about the middle of October and complete its cycle in three and one-half months. About the end of January, then, the second brood would begin, and the adults of this generation emerge about the middle of May. The progeny resulting from the May moths would pass the winter as larvae in approximately five months.

A further note of interest regarding this North American plant-feeding insect in Australia is that the adults are noticeably larger on the latter continent.

TOBACCO DUST AS A CONTACT INSECTICIDE[1]

By P. J. Parrott and G. F. MacLeod,

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Abstract

From the data secured during experimental work reported on the following pages, it is concluded that the finer grades of tobacco dust, containing 1 percent nicotine, are highly toxic to the spirea aphis (*Myzus persicæ*). Observations of the spirea plantings under treatment during the past two seasons also indicate that timely applications of fine tobacco dust would afford adequate protection. In comparison with superfine tobacco, dust mixtures containing free nicotine or nicotine sulfate were, on an average, somewhat more effective but the actual difference in toxicity was not marked.

As the tests were made in greenhouses it is not safe to conclude that finely powdered tobacco would prove equally effective against the same insect under normal field conditions. The insecticidal properties, however, are such as to suggest the desirability of more knowledge of the value and economy of the material in combating other noxious species.

In conclusion it should be noted that commercial grades of tobacco show a lack of standardization since they vary greatly in nicotine content and physical properties. Considering the nicotine content of tobacco dust and commercial brands of tobacco extracts in relation to prices, powdered tobacco is apparently more expensive than the commercial solutions.

In considering the merits of dusting as related to orchard management in New York, there is need of experimental data regarding the value of dust mixtures in combating such insects as the green apple aphis, rosy aphis, leafhoppers, redbugs, pear psylla etc. To combat insects of this character there is not a wide range of available substances with desirable insecticidal properties. At present nicotine sulfate is widely used and recently free nicotine has been recommended for the control of certain species. These are certainly the most effective constituents of dust mixtures which function as contact insecticides, but a serious drawback to their extensive employment is their high cost. The situation reveals the desirability of more knowledge concerning the toxic properties of other substances.

Of the materials considered deserving of more serious consideration than has apparently been devoted to it is tobacco dust, and during the past two years the Geneva Experiment Station began a serious investigation to determine its value in combating the common sucking insects of orchard and farm crops. This paper deals largely with the more important results of tests with tobacco dust against the aphis (*Myzus persicæ* Sulz.) on spirea (*Caryopteris mastacanthus*), a plant which is grown extensively in greenhouses of local nurseries.

[1]Presented at the Meeting of the Division of Agricultural and Food Chemistry of the American Chemical Society at New Haven, Connecticut, April 4, 1923.

The Nicotine Content and Physical Properties of Tobacco Dust

In the Virginia Station Bulletin 208, Ellett and Grisson state "that the nicotine content of tobacco varies greatly, depending upon many factors. The fertility of the soil and the kind of soil both have influence. In curing, the temperature is often allowed to run too high and nicotine is lost by volatilization. To ascertain the amount of nicotine, chemical analysis is required." The nicotine content of Virginia tobacco is as follows: Stems, 0.48 to 0.60 percent; sweepings, 0.73 to 0.88 percent; N. L. Orinoco, 5.35 to 5.62 percent; olive, 3.63 percent; light, 2.9 percent; smoker, 2.30 percent; wrapper, 3.05 percent; cutter, 3.46 percent; dark, 2.83 percent; medium smoker, 3.76 percent; and common smoker 2.47 percent. "Stems had less nicotine content than leaves and dark varieties of tobacco, as Narrow-Leaf Orinoco and Burley, had higher ratios of nicotine than bright or flue-cured types."

There is, apparently no standard for tobacco dust either with respect to nicotine content or physical condition. In comparison with the foregoing figures, it is interesting to note that analysis of various lots of tobacco dust purchased in the State of New York showed considerable variation in nicotine, as follows: Sample 1, 0.88 percent nicotine; Sample 2, 0.58 percent; Sample 3, 0.50 percent; Sample 4, 0.95 percent; Sample 5, 0.98 percent; and Sample 6, 1.00 percent.

A few grades of tobacco dust purchased during the past summer were quite fine, but the larger number of samples contained a considerable amount of coarse material. Most preparations consisted of fine and coarse particles in varying proportions. A common constituent of tobacco was clay or dirt or other cheap adulterant substance or filler.

In our experiments we used a tobacco dust which was guaranteed to contain 1 percent nicotine. The physical properties of this tobacco dust were as follows: Less than 50-mesh screen, 18 percent; 50-mesh, 27 percent; 100-mesh, 1 percent; 150-mesh, 10 percent; and 200-mesh, 44 percent.

To obtain larger amounts than were available of the more finely pulverized material, the tobacco dust was ground for six hours or more in a ball machine. This is not an entirely satisfactory outfit for the purpose because of the large amount of time required for grinding and its failure to pulverize completely all the coarse particles. Regrinding, even with this machine, did improve greatly the physical properties of common grades of tobacco dust. This is shown by comparing the foregoing figures relative to untreated tobacco dust with the accompanying analysis of a sample which was subjected to grinding for several hours:—

Less than 50-mesh, 1 percent; 50-mesh, 11 percent; 100-mesh, 2 percent; 150-mesh, 12 percent; and 200-mesh, 74.5 percent. Supplies of tobacco dust of different degrees of fineness were obtained by passing the reground material thru screens of designated sizes.

Toxicity of Coarse and Fine Tobacco Dusts

In this series of tests commercial tobacco dust and reground tobacco of different degrees of fineness was applied at the rate of 5 grams to each spirea, the material being applied carefully in order to insure thoro treatment. Sheets were attached firmly to the collar of each plant and "tanglefoot" was applied to the edges of the sheets to prevent the insects from escaping. Twenty-four hours after treatment the number of dead and live insects were counted. With the exception of the coarser grades of tobacco dust all or a majority of the insects were usually dislodged by the applications, and there is little doubt that the plants received greater protection than is indicated by the recorded killing efficiencies. The data are presented in Table 1.

A study of the foregoing data shows plainly that the finer grades of tobacco dust possessed greater killing powers than the coarse preparations. The 200-mesh material obtained from the reground tobacco was superior to other grades in its toxicity to the aphids and in its physical condition. Tobacco dusts of 50-mesh fineness or coarser displayed low killing power and poor adhesive properties.

Effects of Hydrated Lime on the Physical and Insecticidal Properties of Tobacco Dust

Chemical analyses demonstrated that hydrated lime in combination with tobacco dust promoted the liberation of nicotine. Observations also indicated that the incorporation of light fluffy material such as lime hydrate of 200-mesh fineness improved the physical condition of tobacco dust. To determine the influence of these factors a series of tests were undertaken, the results of which are indicated in Table II.

It will be observed that in general the mixing of hydrated lime with tobacco dust resulted in decreased toxicity, and that the loss of insecticidal efficiency increased proportionately with the amount of lime added. Mixtures containing 10 percent lime hydrate were not as effective as undiluted tobacco dust but they were more toxic than those containing 25 percent hydrated lime. On the other hand the physical properties of tobacco dust, especially the coarser grades, were considerably enhanced by the addition of lime hydrate. Altho lime tends to liberate nicotine, its failure to affect appreciably the insecticidal properties of the mixtures

TABLE I.—EFFECT OF FINE AND COARSE TOBACCO DUST ON *Myzus persicæ*

Grade of Material	Experiment No. 1		Experiment No. 2		Experiment No. 3		Experiment No. 4		Experiment No. 5		Experiment No. 6		Experiment No 7		Total No. of insects	Average Perc't killed
	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed		
Tobacco Dust																
50 mesh mixture............	310	27	303	10	320	20	411	14	287	21	342	18			2033	18.3
100 mesh mixture............	213	80	367	76	245	77	406	75	345	71	435	74			2006	75.5
150 mesh mixture............	312	72	361	70	314	65	487	55	270	68	351	70			2095	66.6
200 mesh mixture............	303	71	308	62	312	61	423	52	214	55	354	65			1914	61.0
Reground Tobacco Dust																
50 mesh mixture............	295	22	227	36	305	10	420	07	280	06	272	02	422	04	2221	12.4
100 mesh mixture............	236	77	256	72	212	65	391	74	386	67	225	70	330	68	2036	70.4
150 mesh mixture............	309	70	354	72	429	74	214	87	306	77	277	74	330	76	2219	75.7
200 mesh mixture............	339	90	529	94	377	92	260	92	377	95	294	89	415	88	2591	91.4
Grand Total No. of insects:—															17115	

TABLE II.—EFFECT OF ADDITION OF HYDRATED LIME TO TOBACCO DUST

Grade of Material	Experiment No. 1		Experiment No. 2		Experiment No. 3		Experiment No. 4		Experiment No. 5		Experiment No. 6		Experiment No. 7		Total No. of insects	Average Perc't killed
	Total No. of insects	Percent killed	Total No. of insects	Percent killed	Total No. of insects	Percent killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed	Total No. of insects	Perc't killed		
Tobacco dust with 10% Lime Hydrate.........	451	96.5	219	93.6	382	90.3	484	89.2	244	86.9	299	90.1	295	91.0	2374	91.1
Tobacco Dust with 25% Lime Hydrate.........	249	84.6	301	83.1	380	92.2	202	86.1	308	85.7	332	86.6	335	87.0	2107	86.5
Tobacco Dust with 50% Lime Hydrate.........	329	83.4	393	93.3	272	82.4	328	74.9	376	82.8	357	76.2	275	77.4	2330	81.5
Tobacco Dust...........	292	95.8	285	98.6	251	92.6	240	96.7	270	92.6	313	93.7	312	96.4	2063	95.2
100 mesh Tobacco.......	203	60.1	321	78.2	201	82.1	114	74.6	621	75.2	241	81.2	301	71.7	2002	74.7
100 mesh Tobacco and Lime 10%............	254	41.6	308	46.1	193	62.4	369	42.9	421	39.9	381	44.7	262	42.1	2188	45.7
150 mesh Tobacco.......	675	98.4	247	75.7	199	91.5	301	87.7	247	90.2	381	89.5	287	90.1	2337	89.0
150 mesh Tobacco and Lime 10%............	237	76.5	222	79.5	210	86.3	373	77.5	287	79.8	341	81.8	369	80.4	2039	78.9
200 mesh Tobacco.......	380	98.9	434	96.8	373	97.9	214	98.1	320	95.1	294	93.5	259	97.6	2274	96.8
200 mesh Tobacco and Lime 10%............	260	97.3	252	94.6	336	96.7	298	94.2	426	95.2	238	92.1	244	93.7	2054	94.8
Total No. of insects:—															21768	

Table III.—Relative Toxicity of 1 Percent Tobacco and Nicotine Dust on M. Persicæ

Material	Experiment No. 1		Experiment No. 2		Experiment No. 3		Experiment No. 4		Experiment No. 5		Experiment No. 6		Experiment No. 7		Total No. of insects	Average Percent killed
	Total No. of insects	Percent killed	Total No. of insects	Percent killed	Total No. of insects	Percent killed	Total No. ins'ts	Percent killed	Total No. of insects	Percent killed	Total No. of insects	Percent killed	Total No. of insects	Perc't killed		
200 mesh Reground Tobacco Dust 1% Nicotine	343	98.9	378	97.2	264	96.6	227	97.5	314	95.5	321	94.1	286	96.7	2133	96.6
Lime Carbonate with 1% Nicotine	299	99.0	271	98.6	302	99.1	268	100.0	274	98.4	382	100.0	287	99.3	2083	99.2
Lime Hydrate with 1% Nicotine	244	94.9	215	99.2	379	99.1	214	100.0	323	99.6	216	100.0	270	99.4	1861	98.8
Sulfur with 1% Nicotine	362	93.0	254	89.9	326	99.2	260	100.0	305	95.5	251	99.7	373	99.6	2131	97.7
Kaolin with 1% Nicotine	252	77.1	277	79.2	340	80.1	267	76.4	229	85.3	339	74.9	485	76.1	2189	78.4
Lime Carbonate with 1% free Nicotine	550	97.1	484	99.8	591	98.1	602	98.9	332	99.1	213	98.7	290	99.7	3062	98.8
Lime Hydrate with 1% free Nicotine	449	97.2	513	98.1	366	94.5	741	98.5	305	99.7	339	98.6	181	96.2	2894	97.5
Sulfur with 1% free Nicotine	314	100.0	482	94.2	245	98.8	508	97.8	228	100.0	326	99.7	203	100.0	2306	98.6
Kaolin with 1% free Nicotine	240	72.5	398	84.2	222	73.8	284	77.5	224	71.5	236	74.6	234	72.6	1838	75.2
													Total No. of insects —		20497	

Table IV.—Toxic Action of Tobacco and Nicotine Preparations to M. Persicae

Material Used	Method of Application	Time required To Act minutes	Total No. of insects	Percentage killed
200 mesh tobacco dust	In contact with insects	3.00	426	95.7
200 mesh tobacco dust	Not in contact with insects	15.00	587	100.0
200 mesh tobacco dust with 25% hydrated lime	In contact with insects	2.75	645	92.9
200 mesh tobacco dust with 25% hydrated lime	Not in contact with insects	7.50	472	100.0
Hydrated lime with 1% nicotine	In contact with insects	0.50	451	97.8
Hydrated lime with 1% nicotine	Not in contact with insects	1.00	437	100.0
Check—No treatment	Not in air-tight jar	——	554	00.8
Check—No treatment	In air-tight jar	——	608	00.0

tested may perhaps be explained on the supposition that the evolution of nicotine was slow.

Relative Efficiency of Tobacco, Free Nicotine and Nicotine Sulphate Dusts

This series of tests were designed to show the comparative insecticidal properties of dust mixtures, containing respectively fine tobacco dust, free nicotine and nicotine sulphate. The different preparations contained approximately 1 percent nicotine and were applied at the rate of 5 grams per plant. The results obtained with the dusts are indicated in Table III.

On the whole, tobacco dust did not exhibit as high a rate of toxicity as did the mixtures containing free nicotine or nicotine sulfate, but the difference in insecticidal properties was, however, not very conspicuous. The free nicotine dusts were more rapid in their paralytic action than those containing nicotine sulfate, and tobacco dust was the least rapid in dislodging the insects. The mixtures in which kaolin was incorporated as a carrier of free nicotine or nicotine sulfate displayed a killing efficiency of less than 80 percent, while the preparations using sulfur and lime carbonate or hydrate as carriers of the nicotine were noticeably more efficient.

Toxicity of the Fumes of Dusting Mixtures

To obtain data relative to the toxicity of the fumes given off by the different nicotine dusts, applications of the materials were made to the walls of large bell jars, after which the jars were placed over plants heavily infested with aphids. In making these experiments care was exercised to prevent any of the particles of the various materials from coming in contact with the bodies of the insects. For the sake of comparison several plants were dusted with the same preparations. The data are given in Table IV.

The insects confined in the dusted bell jars exhibited no apparent signs of unrest, while those on the treated plants began to move immediately after the application and seemed agitated. The aphids began to fall from the dusted plants in half the time required to dislodge those subjected only to the fumes arising from the walls of the jars. Notwithstanding the greater speed with which the dusts in contact with the insects acted the final killing was more complete in the case of the enclosed plants. These insects were killed *in situ* and were usually attached to the leaves by the proboscis which had not been extricated at the time of paralysis. It is also interesting to note that only a very few

insects were dislodged from these plants while a larger percentage of the insects fell from the dusted spireas.

THE CONSTITUTION OF OIL EMULSIONS

By E. L. Griffin, *Associate Chemist, Insecticide & Fungicide Laboratory, Miscellaneous Division, Bureau of Chemistry, Washington, D. C.*

Abstract

In an emulsion of mineral oil with soap and water the mineral oil is divided into very small droplets which are suspended in the watery medium. The soap is added to keep these droplets from coalescing and finally separating out. Its action is as follows: part of it is broken down, the fatty acids being dissolved in the kerosene and the alkali remaining in the water; part of it forms a film between the oil and the water, preventing the droplets from coalescing, thus stabilizing the emulsion; and any excess soap remains in water solution and helps the spreading qualities of the spray.

The breaking down of the soap may be prevented, or at least made negligible, by the addition of excess alkali, thus preventing an apparent waste of soap.

Two emulsions of the type used in practice were analyzed and the distribution of the soap in them reported.

The oil emulsions used as insecticides consist of very small droplets of oil suspended in watery media. An emulsion can be formed of oil and water only, but it is unstable and the components soon separate. A stabilizer, usually a soluble soap, is added to overcome this tendency. In the past there has been little or no definite knowledge as to what happens to the soap in the emulsion and just what part it plays in the process of emulsification. There was, therefore, nothing to guide in the preparation of an emulsion except previous experience as to what produced a satisfactory product. When difficulties occurred, and they were not infrequent, there was often no good explanation for them or guide to prevent them in the future.

In a recent paper[1] the fate of the soap in the process of emulsification is shown to be as follows and in the order given.

1. Part of the soap is broken down (hydrolyzed) into the alkali and fatty acid from which it was originally formed and the fatty acid goes into solution in the oil, leaving the alkali in the water.
2. Part forms a layer or film of uniform thickness around the droplets of oil.
3. All of the soap not used in 1 and 2 remains in the water solution.

Hydrolyzed Soap

Soaps in dilute water solution partially hydrolyze, or break down, into the alkalies and fatty acids from which they were originally made. The

[1] Griffin, J. Am. Chem. Soc., 45:1648 (1923).

fatty acids are very soluble in mineral oils and so are taken up by the oil droplets. This leaves the alkali in the water. The process of hydrolysis goes on until the concentration of the alkali is so great that the tendency to hold the fatty acids in the water in the form of soap is as great as their tendency to go into solution in the oil.

The soap which is thus broken down does not appear to serve any useful purpose and is apparently a total loss. It has been shown experimentally that this loss may be prevented by adding enough alkali to keep the soap from hydrolyzing and freeing fatty acid which would go into solution in the oil. This is in agreement with the work of Briggs and Schmidt[2] who found that small quantities of alkali tended to assist in the formation of emulsions of benzene in soap solution. The fish-oil soap, which is recommended by the Bureau of Entomology for use in making oil emulsions,[3] contains a considerable excess of alkali and is particularly suited to the preparation of oil emulsions. Of course, in the addition of alkali the possibility of injury to vegetation by excessive quantities of it must be borne in mind.

Films Surrounding the Droplets of Oil

If an oil is broken into droplets in water, the droplets readily coalesce and the oil separates out. However, if a soluble soap is present in the water, soap immediately attaches itself to the oil droplets to form films around them. This film prevents the droplets of oil from coalescing and is the essential feature in stabilizing emulsions of this type. It is exceedingly thin; in fact, its thickness is the length of a single molecule of the soap and is the same whether the soap solution from which the film is formed is dilute or concentrated. The quantity of soap necessary to form it is comparatively small. One gram of soap will cover an area of 500 to 1000 square meters, depending on the kind of soap. One very good commercial emulsion contained 66% of oil and had droplets which averaged about 0.0003 centimeters in diameter. These have an area of 2 square meters for each cubic centimeter of oil dispersed. One gram of soap would therefore form the film necessary for from 375 to 750 cubic centimeters of this emulsion. With coarser emulsions (larger oil droplets) less soap is needed. Thus, if the emulsion is 66% oil and has droplets averaging 0.001 centimeter in diameter, 1 gram of the soaps would be used to form the film for 1,250 to 2,500 cubic centimeters of the emulsion.

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[2]Briggs and Schmidt, J. Physical Chem., 19:478–99 (1915)
[3]Quaintance and Siegler, Farmers' Bulletin 908, U. S. D. A. (1918).

If not enough soap, in addition to that broken down to fatty acids and alkali, to form the films for the droplets is present, the emulsion will not be permanent. There will be nothing to prevent the droplets from coalescing and the oil will therefore separate out. There need not, however, be a large excess of soap. It is possible to utilize nearly all of the soap from a solution for the formation of film.

Soap Remaining in Solution

The excess soap remaining in solution in the water is of no value in so far as stabilizing the emulsion is concerned. In the application of sprays, however, their wetting and spreading qualities are of very great importance. Soapy water wets foliage and spreads on it much better than water without soap. This is connected with the lowering of surface tension caused by the addition of soap to water. The surface tension of water is very much lowered by the addition of small quantities of soap. Larger quantities do not affect it proportionately. There is probably, therefore, an optimum concentration of excess soap which may be used in the emulsion. This quantity must be determined by experiment.

Experimental Emulsions

To illustrate the partition of the soap in practice, a kerosene emulsion made by the method of Quaintance and Siegler,[4] using commercial neutral sodium fish-oil soap, was analyzed. It contained 1.80% of dry soap. This was distributed in the emulsion as follows: 8% of the soap was lost by hydrolysis and solution in the kerosene; 12% was used in the formation of films to keep the droplets of oil from coalescing; and 80% remained in the water solution.

Another emulsion was made in the same manner, except that a small quantity of sodium hydroxide (about 30 cc. of normal solution per liter) was added to the soap solution. In this case the droplets were slightly larger than in the first emulsion owing probably to variation in the agitation. None of the soap was hydrolyzed. About 9% was used in the formation of films, and the other 91% remained in the water solution.

DELAYED EMERGENCE OF HESSIAN FLY FOR THE FALL OF 1922

By W. B. Cartwright,
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Abstract

A delayed emergence of Hessian fly occurred within a triangular area bounded by the Mississippi and Ohio Rivers and a line drawn eastward from St. Louis. Ab-

[4]loc. cit. p. 28.

normal conditions of temperature and rainfall were the primary causes of this delayed emergence. Normal emergence consisted of two small waves on September 22 and 30 respectively, from which progeny developed normally. The heavy delayed emergence occurred October 27 to 30 from which progeny struggled through the winter with at least a 25% death rate. Infestation by progeny of the late emergence caused total loss of 24% to 38% of wheat plants sowed on the usual recommended dates and some injury to an additional 24% to 37%.

The emergence of the Hessian fly (*Phytophaga destructor* Say) wherever it occurred throughout the East Central States in the spring of 1922 was normal. The fall emergence for this territory occurred as partially regular and in certain areas markedly irregular. This irregular or delayed emergence was centered within the triangular area bounded roughly by the Mississippi and Ohio Rivers and a line drawn eastward from St. Louis, Missouri. It is intended to review the climatological conditions existing from the time of the regular spring emergence to the delayed fall emergence and to discuss the behavior and economic aspect of the latter.

Climatological data of the U. S. Weather Bureau for Illinois and Indiana, the states invaded by the irregular fly brood, show that for July the average temperature was almost normal. For August in Illinois the state average of temperature was not unusual but precipitation was the least since 1897, the deficiency being as much as three inches in places. In Indiana the mean August temperature was slightly above normal and precipitation deficient. September in Illinois was warm and dry with more clear weather than any year since 1897. Deficiency in rainfall ranged from one to four inches south of the Illinois River with practically no rainfall after the 20th. Temperature in Indiana for September was above normal and precipitation deficient and with minor exceptions practically no rainfall after the 20th. For both Illinois and Indiana October opened with high temperature. For Illinois temperature was 10 to 14 degrees above normal from the first to 6th, 10 degrees below normal from the 12th to 17th, and 12 to 18 degrees above from 27th to 31st. For Indiana the second decade was colder and killing frosts occurred in nearly all counties on the 13th, followed by recurrences on the 18th to 20th. The last week was much above normal. Rainfall for both Illinois and Indiana occurred within periods 6th to 11th, 13th to 16th, and 22nd to 23rd and none for the remainder of the month.

The activity of the Hessian fly was continuously observed at Centralia, Illinois and the following data compiled from the records of this place. Drouth was temporarily broken by rainfall on September 10th and 19th, a total of .6 inch. Almost coincident with this period of moisture, adult Hessian flies appeared September 22nd and represented the first wave of

the normal fly emergence. On September 30th another small wave of flies appeared. The source of these individuals was not determined and oviposition was so light that less than 3% infestation resulted in wheat of volunteer status. Pupariation of the progeny of the first wave began October 18th and was completed October 28th, pupariation of the progeny of the second wave began November 6th and was completed November 17th. Thus ended the normal activity of the fly for the fall.

On the night of October 6th a heavy rainfall supplied all fields with excess moisture. An apparent complete transformation of fly larvae was noted October 16th. Adults issued October 27th to 30th and oviposition was heavy. Over half the progeny entered the winter as small larvae. Pupariation began near the middle of January and ceased in general March 1st though naked larvae were found occasionally to April 1st. Pupariation was not completed as death rate ran high through March and ended the tragic struggle. From records made in December and February a 25% death rate was computed for this interval. After this time no definite figures were obtainable, due to the disintegration of infested wheat plants. Concrete data obtained February 23rd showed a 70% pupariation as a whole for the progeny in early sowed wheat. Closer analysis revealed a greater pupariation of not less than 75% for forms existing in growing plants with less than 50% pupariation in dead plants. In wheat representing the general fall seeding a 45% pupariation existed, with dead plants revealing a range of 38 to 54 in percentage of pupariation. On April 4th dead plants which had been infested showed 26% without fly life. Reversion of larvae in the flaxseeds began March 31st and ended near April 12th. Pupariation occurred from April 16th to 29th and adults emerged April 22nd to May 8th

Mr. W. H. Larrimer of the Bureau of Entomology, noted that a transformation of the Hessian fly did not occur in stubble in the central and northern areas of Indiana during October but that practically all of the larvae remained as "hang-overs" in the stubble. To what extent the killing frosts and low temperatures influenced the behavior of the fly remains questionable. A few irregular flies were recorded by other workers of the Bureau of Entomology at points in the wheat area east of the Mississippi River during the heavy emergence at Centralia, Illinois, but in numbers of no consequence. South of the Ohio River the activity of the fly merged into normalcy of the southern area.

The economic aspect of so heavy delayed emergence is important. The droughty condition of August, September, and early October interfered greatly with fall preparation of wheat land. Seed beds which

were prepared and seeded to wheat remained dust-like until the periodic rains of October. Germination of early seeded wheat was irregular and incomplete until after the rains. Too much moisture immediately after the rains delayed sowings. Hence from the general weather conditions most of the wheat did not appear above ground until two weeks after the recommended dates to evade Hessian fly attacks. It was therefore, in an attractive stage for fly oviposition and in the stage in which plants would greatly suffer from fly injury. There was a three-fold struggle through the winter, a struggle of host and enemy, the death of one meant the death or life of the other, and the composite struggle of both to survive the winter coldness. From 24% to 38% of the wheat plants sowed to one week after the recommended dates died. An additional 24% to 37% of plants on good land and land properly prepared and seeded evaded death by the rapid growth of secondary culms. Late sowed wheat lacked heavy infestation of the fly in the fall and missed winter kill.

RESULTS OF AN OIL SPRAY IN TREATMENT OF BOX LEAF MINER (*MONARTHROPALPUS BUXI*) LABOU.

By Jas. K. Primm, and E. A. Hartley, *Bureau of Plant Industry, Harrisburg, Pennsylvania.*

ABSTRACT

The box leaf miner, *Monarthropalpus buxi* (Diptera, Itonididæ) injuries has resulted in a reduced demand for certain varieties of boxwood. A series of experiments indicate limited usefulness for the molasses spray and very satisfactory results were obtained with a heavy emulsifying petroleum oil, 1–20, and a pint of Black Leaf 40 to 50 gallons of spray, making one or two applications.

A decrease in the demand for certain varieties of boxwood, especially *Buxus sempervirens*, is noted among nurserymen in the eastern part of Pennsylvania and is attributed to the unfortunate experiences which people have had with the box leaf miner (*Monarthropalpus buxi*). The encouraging results obtained by the use of sticky applications to the foliage, designed to entrap the adults at the time of emergence and prevent oviposition, have been largely offset by the cost of material and the multiplicity of failures due to heavy rains during the emergence period which washed off the sticky coating, and entailed a second, or sometimes a third outlay for spray material with a lessened prospect of control.

On estates where a noticeable reduction of infestation has been attained by the most generous use of labor and material, how much credit should go to the molasses treatment and how much to other methods

which are used to supplement this treatment is a matter of conjecture. There is evidence, however, that most of these treatments may just as well be discarded as applied by the average owner of boxwood, laboring under the popular misconception that because it worked for Mr. Smith under one set of conditions it should work for Mr. Brown under an entirely different set. There is no doubt that control could be secured whether the material used is molasses, rosin fish oil soap, tobacco extracts, or any other efficient contact spray, if the time and frequency of applications is properly correlated with the emergence period and the varying weather conditions.

In southeastern Pennsylvania adults have been observed emerging as early as April 17th on imported stock from Holland which had just been unpacked from crates and which doubtless had been kept at a warm temperature in transit. In 1921, emergence under natural conditions was first noted on May 1st, and in 1922 pupation was first noted on April 18th and emergence on May 8th. The period of emergence seems to be regulated by seasonal temperatures, and doubtless must be preceded by a settled temperature of 70° to 80° F. for a period of two or three weeks. In the spring of 1920, which was late, the first emergence was noted by Hamilton[1] in the vicinity of Baltimore, on May 19th.

Recent success with fumigation suggests this treatment as the most certain of accomplishing results, but the expense, as well as danger, incident to fumigation with hydrocyanic gas, and the limited period—when the insect is in the pupal state—in which it has been found to be effective will not warrant its use except in the case of very valuable specimen plants. The elements which are lacking in making the molasses treatment of more general value, cheapness and greater resistance to rain, are thought to be found, in the experience of the writers, in the use of a heavy emulsifying petroleum oil. Its capacity for entangling the adults and checking oviposition is fully as efficient as in the molasses treatment, as indicated from the results of our field experiments in the spring of 1922. The product used is manufactured by the Sun Oil Company, and is free from any animal or vegetable fats. It has a Baumé registry of 16 to 17 degrees and viscosity of 1200 at 70° F.

The outcome of a number of preliminary experiments with various materials to ascertain their effect on the foliage of boxwood with a view to killing the larvae in the leaves or of causing the foliage to drop, was negative, but it was in the incidental use of this oil as a spreader for "Black Leaf 40" that its extremely viscous and adhesive properties were

[1]Jour. Econ. Ent., Vol. 14, No. 4, August 1921, pp. 359–365.

first demonstrated. A few plants were then sprayed with one part of oil diluted with twenty of water and were left for observation. Little foliage injury followed and when thoroughly dried there was left a heavy oily blanket which was evenly distributed over both the old and new growth and which did not wash off in a heavy rain.

Because of the large number of heavily infested boxwood on one of the private estates near Philadelphia, the cooperation of the superintendent was obtained and a long section of hedge of *Buxus sempervirens* was reserved for treatment with this oil. Preparations were made to spray the bulk of the boxwood with resin fish oil soap (ten pounds to fifty gallons) and "Nikoteen" (one pint to fifty gallons of the soap solution). A large nursery also adopted this treatment, using "Black Leaf 40" instead of the "Nikoteen." It was discontinued by both parties after a few applications and the remaining sprays consisted entirely of the oil solution. A neighboring estate proposed to spray its boxwood with a good grade of "black jack" molasses (one part to three of water) and "Black Leaf 40" (one part to 264 of the molasses mixture). A commercial firm undertook the fumigation of about fifty fine specimen box on the latter estate with a guarantee of its success. The first applications of spray were given on May 9th, the day after the emergence of the first adults. In all of the oil applications (1-20), "Black Leaf 40" was used (one part to 500 of the spray).

Counts were made the first three days after the applications of the spray to determine the comparative number of adults which had emerged successfully, with the number found trapped in the spray and the number of extruded pupae which failed to emerge successfully. Similar counts were taken from twigs of bushes sprayed with the resin fish oil soap and the molasses mixtures. The final percentages of control are based upon counts made the following July of the number of eggs successfully hatched, as it was found a large percentage of the eggs which were deposited in both the treated and check plants were either infertile, or else did not develop from other causes which were not ascertained. The checks in each case were untreated plants of a similar degree of infestation as the plants which were treated. The oil spray was applied by the writers with a small compressed air sprayer; the molasses and resin fish oil soap sprays were applied by workmen on the estates with a barrel pump outfit.

Oil Applications

Exp. 1. Sprayed *May 9th* with "Sun Miscible Oil" (1–20) and "Black Leaf 40" (1–500).

Exp. 2. Sprayed *May 9th & May 11th* with "Sun Miscible Oil" (1–20) and "Black Leaf 40" (1–500).

Exp. 3. Sprayed *May 9th* with "Sun Miscible Oil" (1–20) and "Black Leaf 40" (1–500), and on *May 12th* with "Black Leaf 40" only, (1–500).

Exp. 4. Sprayed *May 9th & May 12th* with "Sun Miscible Oil" (1–20) and "Black Leaf 40" (1–500) and again on *May 20th*, with the same, following a heavy two-day rain on May 17th and 18th.

Exp. 5. Sprayed *three times* as in Exp. 4. The preceding experiments were confined to sections of the hedge, the latter to a heavily infested isolated bush, much taller and with more open foliage than in the case of the hedge.

Resin Fish Oil Soap, Molasses and Gas Treatments

A. Sprayed with resin fish oil soap (10 lbs. to 50 gallons) and "Nikoteen" (one pint to 50 gallons of soap solution) on *May 9th & 10th.*

B. Sprayed with molasses (1–3) and "Black Leaf 40" (1–264) on *May 11th.* No adults emerged on this bush until May 10th.

C. *One application* as in B., and *two succeeding ones* following rains on May 17th & 18th which washed off those preceding.

D. Fumigated by commercial firm with hydrocyanic gas *May 6th & 7th,* three hours exposure each time. Dosage not known. Many miners still in larval stage.

E. Fumigated as in D once only, on *May 10th.* Three hours exposure. Dosage not known. Most of miners in the pupal stage.

The following tabulation shows the counts made to determine the relative number of adults successfully emerged, adults trapped in the spray, and those killed by contact before emergence was complete. No counts were taken from parts of bushes from which counts had previously been taken.

Table I.

Exp. No.	Counted	Successfully emerged	Trapped	Killed by contact
Oil Applications				
1	May 10	120	150	166
1	May 11	391	392	120
1	May 12	315	152	30
2	May 12	527	486	163
3	May 13	55	40	37
4 & 5	No counts			
Other Treatments				
A	May 10	27	7	112
A	May 11	230	16	274
A	May 12	222	4	39
B	May 13	45	40	140
C	No counts			
D	May 11	0	565 dead; 77 alive	Checks, all
E	May 11	0	1029 dead; 2 alive	emerged

The oil sprays (Experiments 2–3) accounted for a high percentage of trapped adults, and the efficiency of the nicotine is shown by the large number which were unable to emerge successfully and were killed by contact. The resin fish oil soap spray (Treatment A) possessed very little merit in entangling the adults, but the addition of nicotine sulphate

as in the oil sprays, greatly increased its efficiency. The diminishing power of the tobacco extracts is noted on the third day when the relation of the number killed by contact to the number successfully emerged, is seen to be very much smaller. The maximum emergence was not reached until two or three days after the last count was made. As the resin fish oil soap failed to check them after the third day either by trapping the adults or killing by contact, without fresh applications, the workmen changed to the oil treatment and further experimental value was therefore complicated. The molasses treatment (Treatment B) yielded less data for comparison, as most of the plants having a high infestation had first been fumigated, or had been fumigated before much emergence had taken place. The counts were taken from one small bush, and at a time when comparatively few adults had emerged, but would indicate a good control. A steady rain through the 17th and 18th washed off the spray, however, and on the day following, when the bush was unprotected, swarms of adults emerged and oviposited in the leaves. Two more applications were given after an interval of two or three days, but only 15.4% control was obtained (See Table 2, Treatment C). The hydrocyanic gas treatments (Treatments D and E) yielded very promising results, but should not be construed in favor of this treatment without qualifications. The high kill in Treatment E is probably due to the fact that a large percentage had reached the pupal stage, rather than in a perfection of the treatment. The 79 individuals recorded as alive in both treatments were larvae. Furthermore, a very high temperature was generated in the tent during fumigation, which the operator claimed was due to some secret process in connection with the treatment. A maximum and minimum thermometer which was placed in one of the tents during fumigation, went to its limit, 130° F. All the tender young growth was killed back. Experiments using heat as a treatment probably would yield some interesting results.

TABLE II.

Exp. No.	No. of leaves infested	No. of larvae in infested leaves	No. of leaves uninfested	Percent kill
2	150	200	3300	91.0
Check	774	1474	1389	
3	189	262	2793	87.1
Check	774	1474	1389	
4	646	1087	6183	86.0
Check	2381	5513	2369	
5	313	392	2776	92.0
Check	1147	2787	610	
C	588	920	1009	15.4
Check	774	1474	1389	

The above tabulation shows the counts of newly hatched larvae

taken from the treated and check plants and the percentages of theoretical kill obtained by the various treatments. All the counts were taken in July. Twigs were taken at random, stripped carefully of every leaf, and the counts taken from these leaves.

The large counts made in order to obtain the above percentages, and the large scale on which these sprays were used, especially in treating thousands of valuable nursery boxwood, will greatly strengthen the foregoing results. So many varying conditions, such as exposure of the plants, different varieties, close or open growth, shade and sun, number of applications given, etc. afforded every opportunity for studying the effect on the plants and whether oil sprays of this type could be applied safely without a number of qualifying precautions. Outside of the slight spotting, noticeable the first day or two after the application of the spray, no perceptible signs of injury could be observed, and at this writing (Oct. 2, 1922) the treated plants are in a fine healthy condition. The results of the experiments would indicate that one or two applications of the oil at a strength of one part to twenty of water, with the addition of a pint of "Black Leaf 40" to fifty gallons of the spray mixture, given about the first of May or shortly before the beginning of emergence, will be sufficient to greatly reduce an infestation, and that a repetition of the treatment will not be necessary even after forty-eight hours of hard rain. If the first application is a thorough one, the second one should probably follow in about one week, or just before the height of the emergence. A low pressure is advisable in applying the spray.

KERNEL SPOT OF PECAN CAUSED BY THE SOUTHERN GREEN SOLDIER BUG

By William F. Turner, *Georgia State Board of Entomology*

Abstract

Kernel spot proves to be a physiological trouble, resulting from the feeding of Hemiptera, particularly *Nezara viridula* L. As a result of such feeding the tissue of the kernel breaks down for a short distance around the puncture, resulting in a hemispherical discolored portion. This becomes bitter and imparts its bitterness to the whole kernel. Only the kernel is affected and the trouble cannot be detected until the nut is cracked. The insects can cause kernel spot only during the period when the kernel is hardening. They do not breed on pecans; only the adults feed on the nuts. Cowpeas and soybeans, being important breeding hosts, should not be used as cover crops in the orchards.

Kernel spot of pecan is, as the name indicates, an affection of the kernel. When the spots are few in number they are nearly round, as seen on the surface; when abundant, thru running together, they become irregular. At first the spots show only the slightest discoloration; later

they commence to darken and in time become very dark brown in color. This discoloration may also extend beyond the limit of the actual "spots" in severe cases. A horizontal section of the spot is almost a semicircle, the diameter being the surface of the kernel, showing that the spot is actually a more or less perfect hemisphere. This hemisphere is very distinct in that, at an early stage, it is outlined in brown, and later the entire affected area becomes discolored. An examination of the spot, in section, shows that the cells are all collapsed, giving a gross appearance of sponginess. One other characteristic is that a majority of the spots occur on the ridges of the kernels; i. e., on the portion nearest the shell. At first the affection seems to have no effect upon the flavor of the nut but after a short time the spot itself becomes bitter and this bitterness is finally imparted to the entire kernel.

Kernel spot usually affects only those varieties which have the thinnest shells, and plump meats. Thus Schley and Curtis nuts are frequently attacked very severely, as much as 50% of their crop being ruined, while such varieties as the Stuart (thick shell) and Frotcher (non-plump meat) will escape injury, though growing next to the susceptible varieties.

The trouble is of very serious importance to the growers of pecans. True it occurs only in slight amounts during most years but occasionally as in 1916 and 1921, in Georgia, fully a quarter of the crop is affected in many groves. Furthermore the losses are particularly severe in that no indication of the trouble can be seen until the nuts are cracked. As a consequence quantities of nuts are shipped in perfect good faith by the growers and pass thru the channels of trade until they reach the final consumer. The finding of spoiled nuts immediately reacts thru retailer and wholesaler to the grower and in most cases the latter is obliged to recall his product. Thus there is a loss not only of the crop itself but of the freight both ways and the good will of the public. Had the grower known of the trouble in the beginning the nuts could have been sold, at reduced prices to be sure, to the crackeries.

Very little has been published concerning kernel spot. This is probably due to the fact that the trouble has not been a major one every year. Rand first gave the trouble some attention.[1] He stated that kernel spot was a fungus disease and isolated a fungus, *Coniothyrium caryogenum* Rand, which he pronounced to be the causative agent.

In 1916 the writer observed what appeared to be a correlation between kernel spot and the use of cow peas as a summer cover crop. Several

[1]Rand, Frederick V., 1914. Some diseases of pecans. In Jour. of Agr. Res., Vol. 4. pp. 303–338.

growers noted the same phenomenon.[2] A study of the situation revealed the fact that the peas were heavily infested with the Southern Green Soldier Bug, *Nezara viridula* Linn., and that these bugs were also present to some extent on the pecans. These observations together with the fact that thin shelled varieties with plump meats were more subject to the trouble than were those which had thick shells, led to the thought that there might be a connection between the insect and the "disease."

In 1917, the writer conducted a few preliminary experiments, caging the bugs on clusters of seedling nuts. While far from being conclusive these experiments indicated very strongly that the suggested relationship was an actual one. There was no indication, however, as to whether the spot was an injury due directly to the insect or the insect acted as the carrier of a disease.[3]

In 1921 Demaree conducted a much more extensive experiment along similar lines. He attacked the problem from the pathologist's standpoint, his main purpose being to determine, in case the suggested relationship was confirmed, if the actual cause of the trouble was a disease or simply an injury directly due to the bug. Demaree's work showed conclusively that kernel spot is caused by the feeding of *Nezara viridula*, this feeding resulting in the extraction of all liquid from a hemispherical area centering about the point of attack, with a resultant collapse of the cells affected; and that no fungus or bacterial organism is concerned in the trouble.[4]

During the past season experiments have been undertaken to clear up several other points with regard to the relationship of the insect to the spot. For this series, some hundred cages were put in place during the second week in August. The varieties of pecan used were Frotscher and Teche; these varieties being chosen for reasons of accessibility altho they are not as subject to kernel spot, under normal conditions, as are many others.

Commencing on August 21, five adults of *Nezara viridula* were placed in each of 10 cages and left for a period of about 10 days. They were then removed and other insects were placed in 10 more cages. This process was followed throughout the season till harvest time. The cages were not removed until the nuts were gathered. In each case, when insects were introduced into cages, nuts were cut and photographed

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[2]Credit for the first observation of this apparent correlation belongs to J. B. Wight, a pioneer grower of budded pecans, of Cairo, Ga.

[3]Turner, William F., 1918. Nezara viridula and kernel spot of pecan. In Science n. s., V. 47, No. 1220, pp. 490–491.

[4]Demaree, J. B., 1922, Kernel spot of the pecan, and its cause. U. S. Department Agr. Bul. 1102.

to show the condition of the shells and kernels. At harvest time all nuts were gathered and examined.

The following table gives a résumé of the results obtained in this experiment. The actual dates given in the table are only of general importance. These would vary in any one year, according to the variety under observation, since the ripening period varies considerably with different varieties. The time would also vary from year to year according to seasonal variations. The stages of growth and maturity of the nuts, as indicated by the photographs, give an index which will hold true for all varieties and all seasons.

Table I

Series	Cages	Date	No. Nuts	Results
I	1–10	8/21–9/1	24	All nuts dropped off; no spots.
II	11–20	9/1–9/11	23	All but five nuts dropped; all show spots
III	21–30	9/11–9/20	22	All kernels had spots; total of 117 spots.
IV	31–40	9/20–10/4	21	All kernels had spots; total of 187 spots.
V	41–50	10/4–10/12	26	13 nuts with spots (50%); total 83 spots
VI	51–60	10/12–10/19	29	1 nut with spot; 1 spot.
Check	61–100	Harvest	136	No spot.

In studying this table it is necessary to correlate the results with the condition of the nuts. These are shown in plate 6. In series I all nuts dropped from the stems. This is clearly due to the insect attack in that none of the nuts in the check cages dropped. An examination of these nuts after they had been off the tree for some ten days did not reveal any evidence of kernel spot whatever. Plate 6, fig. 3 shows the condition of the nuts at the beginning of this period and figure 4 that at the end. It will be noted that the true condition for our consideration is most nearly like that in figure 3, in as much as the nuts all dropped within five days of the time when the insects were introduced. At that time the shell was still very soft and thin. The skin of the kernel was formed, but none of the meat, this still being in liquid condition. As a result of this condition there was nothing in the kernel in which a spot could form.

In the second series 18 out of 25 nuts dropped (72%). All of these, together with the nuts which remained on the tree, developed spots. Figs. 4 and 5 on plate 6 show the condition of the nuts at the beginning and end of this period. In figure 4, the kernels have begun to form on the inside of the skins. At the end of the period a very marked development has taken place altho the kernels are still far from plump. Through-

out this period the kernels were sufficiently formed to allow of the development of the spots.

During the time of the 3rd and 4th series, in which 100% of the nuts were affected (and none dropped), figures 5 to 7, plate 6, the shells were still fairly soft; the nuts with plenty of meat for attack; but the meats were not at all mature, and liquid could be extracted with the resultant collapse of the cells.

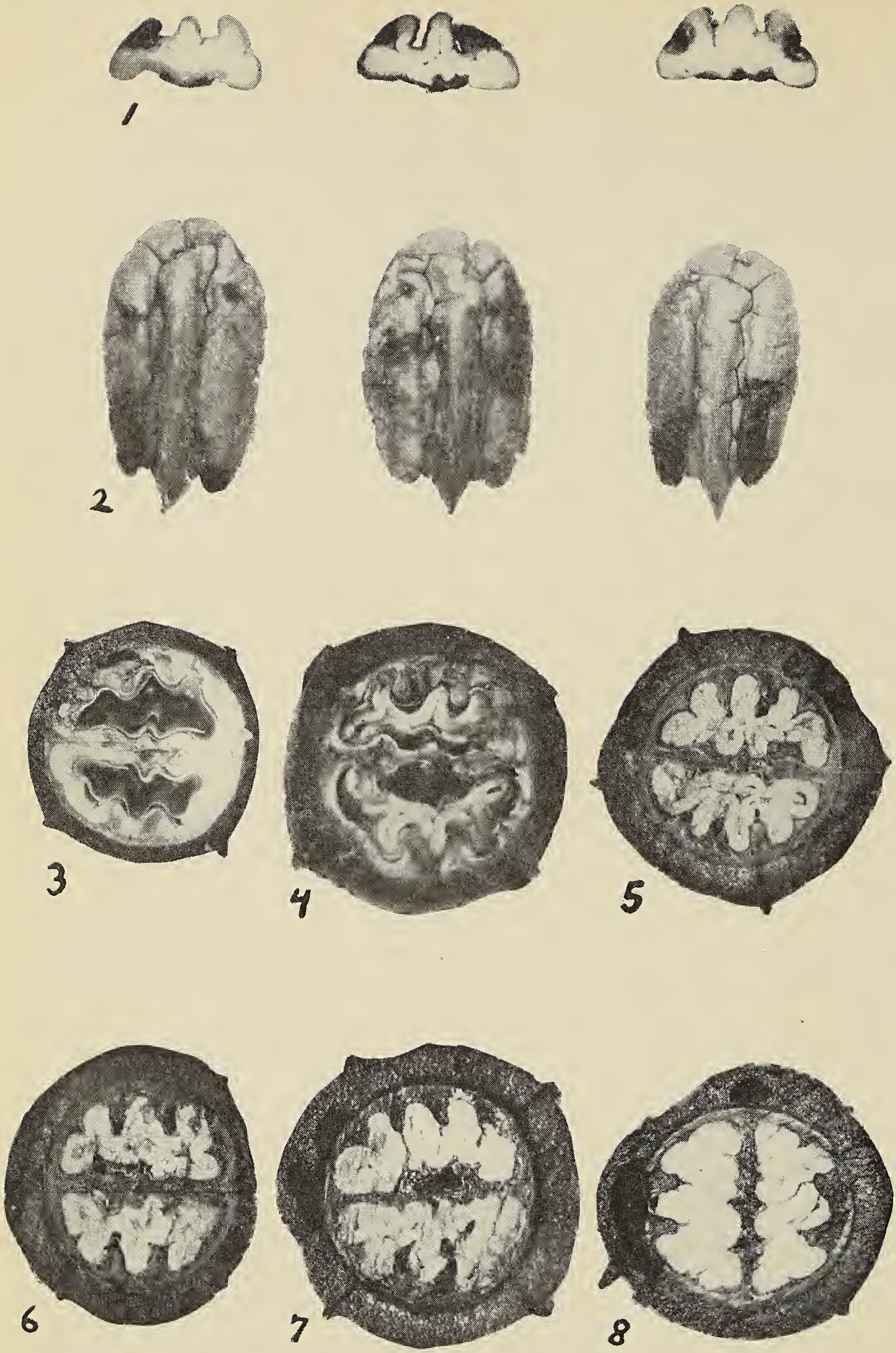
From the time the kernels commenced to mature, figures 7 to 8, the percentage of affection decreased. There was no change of appearance in the spots formed in this 5th period and the number per nut did not decrease materially. The nuts of course varied somewhat in their rate of development and the results obtained simply indicate that at the beginning of this period 50% of the kernels were so well hardened that feeding by the insects failed to empty the cells or to break down their walls.

After the stage shown in figure 8, kernel spot could not be produced by the insects. In series VI only one spot was produced, and this was on a kernel which was obviously not as mature as the other nuts of the series, at the time of examination.

The adult insects fed very freely on the nuts, up to the time of harvest. Even after the shucks had split the insects continued their attack, forcing themselves between the loose shuck and the shell and thrusting their beaks directly through the shells. The bugs are able to pierce the shells even when these are so hard that it requires considerable strength to crack them, as when they are ready to be harvested.

Kernel spot is caused only by adult insects. Nymphs in the last instar were confined in several cages. Of these only one was able to molt and no spots occurred on any of the nuts. Some twenty batches of eggs laid by females in the cages, were allowed to remain and hatch, naturally. All of the young molted once, since they do not feed in the first instar, but of over twelve hundred nymphs only four reached the third instar; and these died in that stage.

This brings out a very interesting point that while the pecan is a feeding host of the bug, it is not a breeding host. The insects breed most freely, in South Georgia, on legumes, and of these cow peas, soy beans and mung beans appear to be the favorites. Other common breeding hosts are okra, and cotton. Various observers have reported the species as attacking practically every garden and field crop grown in the south but, unfortunately, no attempt has been made to distinguish between breeding hosts and feeding hosts, so a complete list of the former can not be given at present.



Pecans Injured by Southern Green Soldier Bug

1. Cross section of spots. 2. Spots as seen from the surface. 3, 4, 5, 6, 7, 8 sections of nuts gathered Aug. 21, Sept. 1, 11, 20, Oct. 4 and 12 respectively.

After it had been proven that kernel spot was purely a physiological breakdown following the feeding of a bug, it seemed quite possible that other species might have the same effect. With this point in view six adults of a species of Euschistus were confined in two cages and eleven adults of *Leptoglossus phyllopus* F. were confined in three cages. The results are given in table No. 2.

Table II

Insect	Cage No.	No Nuts	No. Spots
Euschistus Sp.	1	2	4 & 12
"	2	2	0
L. phyllopus	1	3	0, 9 & 9
" "	2	5	0, 0, 0, 2 & 4
" "	3	3	1, 3 & 1

The spots caused by these two species appeared to be exactly like those following the attack of *N. viridula*, and these results simply confirm the conclusions already reached, as to the nature of the trouble. From the practical standpoint the interest of the grower should still be confined to the Green Soldier Bug, since that is the only species which has been found in sufficient numbers to cause any economic injury.

One thing has impressed the writer most strongly during the study of this trouble, and more particularly in the study of the literature concerning the Southern Green Soldier Bug. This is the lack of careful study directed toward an understanding of, not only this species, but of the Heteroptera in general. There seems to be no doubt that such study will solve many of our present problems as well as many of those of the plant pathologist. The field is practically a virgin one and I believe offers the best opportunity to the beginner in Entomology today.

A NOTE ON THE HONEY DEW PRODUCTION OF THE APHID, *LONGISTIGMA CARYAE* HARRIS

By William Middleton, *U. S. Bureau of Entomology*

Abstract

Observations on the aphid, *Longistigma caryae* Harris, at Washington, D. C., showed that it remained active, excreting honey dew, later in the year 1922 than had been previously recorded. Weather reports reveal late excesses of temperature associated with this record and a brief summary of reports of the occurrence of the species with some extracts from literature are included.

During the latter part of October a number of complaints of annoyance by honeydew were received at the Bureau of Entomology, U. S. Department of Agriculture, from residents of Washington, D. C., Jersey City, N. J., and Philadelphia, Pa. Some examinations of trees in certain sections of the Capitol City were made on October 26, 1922, and a large aphid, *Longistigma caryae* (Harris), was found to be abundant in clusters along the under sides of large limbs on a number of sycamore shade trees. Specimens from Jersey City showed the same aphid and a brief description of a louse associated with the Philadelphia complaint agrees with this species though not to an extent permitting a positive determination. At Washington, D. C., the trunks and branches of a number of sycamores and the side-walks and fences beneath showed decided traces of the sweet liquid excreta of the aphids and a cluster low on the trunk of a young sycamore was observed to show some fresh globules of honeydew although the day was cool. Further, the dropping of this material from the trees in certain sections of the city soiled the clothing of passersby and automobiles parked and passing beneath and attracted some unwelcome insect visitors.

On the 14th of November the aphids were still present in masses and a yellow jacket (*Vespula* sp.) was observed flying about those on the young sycamore where there was still some trace of fresh moist honeydew on the baık.

Since there seems to be no previous record for production of honeydew by this species of aphid at this geographical position (Latitude 38° 53′ 17″ N. Longitude 77° 1′ 34″ W. of Greenwich, Altitude 160) so late in the year, the observation should be worth recording and it may be of interest to review the weather conditions at Washington, D. C., during the months of September, October and early November as a factor probably contributing to this possibly unusual occurrence. The summer had been warm and dry and arranged below are the weekly average temperatures, precipitations and excesses or deficiencies for the period mentioned.

TABLE I.—DISTRICT OR STATION OF REPORT, WASHINGTON
(From "Weather, Crop and Markets" Pub. weekly by U. S. Dept. Agric.)

Date of Publication 1922 Week	Period of Average	Average Temperature (±)	Total Precipitation (±)
Sept. 2	(Week ending Aug. 29)	72 (—1)	0.4 (—0.5)
" 9	(" " Sept. 5)	75 (+3)*	5.5 (+4.8)*
" 16	(" " " 12)	76 (+6)*	1.1 (+0.2)*
" 23	(" " " 19)	69 (+1)*	1.1 (0)
" 30	(" " " 26)	65 (—1)	0 (—0.8)
Oct. 7	(" " Oct. 3)	65 (+2)*	0 (—0.6)
" 14	(" " " 10)	72 (+11)*	1.0 (+0.4)*
" 21	(" " " 17)	61 (+3)*	0.2 (—0.4)
" 28	(" " " 24)	53 (—2)	0.1 (—0.8)
Nov. 4	(" " " 31)	52 (0)	0 (—0.8)
" 11	(" " Nov. 7)	55 (+5)*	0.1 (—0.6)
" 18	(" " " 14)	53 (+6)*	0 (—0.6)

In the above review of the weather the preponderance of plus or excess averages (those indicated by the *) are doubtless of especial significance in the late activities of the *Longistigma.* Not only were these apparently favorable to the aphid but they probably produced a stimulating effect on and an increase of sap in the trees which the previous rather scanty rainfall had depressed.

Bureau of Entomology notes[1] of various years on *Longistigma caryae* Harris contain the following records of occurrence for the species.

April 30	August 6, 7, 11, 17, 20 and 28
May 5	September 4, 5, 9, 9, 14, 17, 17, 21, 27 and 29
June 9 and 26	October 16 and 25
July 7 and 24	November 4

These notes point to a maximum appearance during August and September, and while recording the presence of the aphids as late as November, still show no observations on its production of honeydew on this date in the latitude of Washington.

Clarke[2] records the species in early November of 1906 at Montgomery, Alabama, (Latitude 32° 21′ N. Longitude 86° 25′ W., Altitude 222) on the undersides of limbs of sycamores. The colonies were large and honey dew abundant. Townsend[3] observed this aphid abundant on western plane trees at Washington in 1888. His note mentions the staining of the pavement beneath infested trees both in September and October. Davis[4] has recorded *L. caryae* present during October in northern Illinois but does not mention it's honeydew production at this time. Wilson[5] states that at Washington, D. C., he has observed egg-

[1]Kindly furnished by Dr. A. C. Baker.
[2]Clarke, Warren T. Ent. News, Vol. 18, pp. 187–188.
[3]Townsend, T. Insect Life, Vol. 1, No. 6, Dec. 1888, pp. 197–198.
[4]Davis, John J. Jour. Econ. Ent., Vol. 3, p. 413.
[5]Wilson, H. F. Can. Ent., Vol. 41, 1909, p. 385.

laying females as late as December 2 but includes no information concerning honeydew production at this time of year. Weed[6] records sexed forms in late September and in entire October but makes no mention of late honeydew production. Finally Sanborn[7] reports the aphid enduring all temperatures to 0° F. but gives no information regarding its production of honeydew at low temperatures.

According to the information in the Bureau of Entomology files this species of aphid has a wide range of host plants but the above record of its late production of honeydew at Washington, D. C., is made only from observations in which sycamore served as the host.

LIFE HISTORY OF *MICROMUS POSTICUS* WALKER[1]

By C. R. Cutright, *Ohio Agriculture Experiment Station, Wooster, Ohio*

Abstract

The Hemerobiid larva, *Micromus posticus* Walker was collected with other aphid predators, the life history worked out and an estimate of its economic status made.

While collecting aphid predators in the field during the summers of 1921–22, a Hemerobiid larva was noticed quite often. A number of these were brought into the laboratory where they were bred out, the adults proving to be those of the brown lacewing, *Micromus posticus* Walker. An attempt was then made to obtain literature dealing with this insect but nothing except the description of the adult and a few casual notes dealing with the larva were found.

Rearing

The eggs that were brought in from the field were placed in vials closed with a cotton plug. As soon as they hatched the young larvae were transferred to inverted petri dishes where they were provided with aphids as food. This method of rearing was very successful but one difficulty was encountered. The first instar larvae are very small and the exuviae can not be detected by the naked eye. In order to determine the time of ecdysis it was therefore necessary to make a microscopic examination of the contents of the dish each day. In order to have a smaller quantity of material to examine the young larvae were placed on white paper and a very small, thin watch glass inverted over them. Aphids were then introduced independent of any plant tissue. Exami-

[6]Weed, Clarence M. Insect Life, Vol. 3, pp. 286–287.
[7]Sanborn, Charles Emerson. Kans. Univ. Sci. Bull., Vol. 3 (1904) p. 30.

[1]Contribution No. 71, from the Dept. of Zoology and Entomology, Ohio State University.

nation of everything under the watch glass could then be made with little trouble and in this way the number of larval instars was established.

Life History

The eggs are found on the underside of the leaves of plants, usually those that are infested with aphids but not always. They are placed in irregular groups, containing one to thirteen eggs each, some may touch but others may be a centimeter or more apart. The long axes of the eggs frequently parallel each other but exceptions to this are almost the rule. They lie perfectly flat on the leaf surface to which they are rather insecurely attached. There is no sign of the egg being stalked. Eggs were collected in the field from June to the first of October. Though never abundant a few hours search would usually bring several to view.

Females that were confined in cages with aphid infested plants placed the eggs in the same relative position as those found in the field. When they were confined in vials or in petri dishes the eggs were deposited on the nearest convenient surface regardless of what it was or of its position relative to light.

Several incubation records were taken in August and September. The average length of time required for hatching is four days with variations of only a few hours, more or less, from this period.

The larvae are easily the most conspicuous of the different stages. Their usual habitat is, as might be expected, plants that are infested with aphids, where they are found on the lower surfaces of the leaves or running up and down the stems. I have collected them usually on herbaceous plants. Banks states that they are common on aphid infested trees where they are found on the leaves.

The larvae, in hunting for food, move about the leaf changing direction frequently. If the movement is slow the tip of the abdomen is usually attached to the leaf, the legs carry the body forward till it is stretched out as far as possible. The tail is then released, the abdomen is humped up and the tip re-attached. If the movement is rapid the abdomen is carried elevated, not touching the leaf, usually being humped about the fourth and fifth abdominal segments. All the time that movement is going on the head is continually being shifted jerkily from side to side. This is a very characteristic action on their part.

The palps and jaws seem to be the structures used in locating food. The antennae touching the aphid bring very little response on the part of the larva. When a live aphid is located the head is drawn back and then thrust sharply forward, the mandibles piercing the body wall. I

believe this thrusting motion to be necessary on account of the comparative straightness of the mandibles. Were they more curved a pincher-like action might be used. After a hold has been secured by the mandibles violent struggles and extrusions of glue on the part of the aphid usually fail to secure its release. The larvae hold on tenaciously, bracing themselves with their feet, and frequently anchoring themselves by the tip of the abdomen. Every cast skin or sucked out aphid body that is encountered in the search for food is attacked as though it were alive. Skins such as these frequently become caught on the mandibles in which case the larva will wipe its jaws across the surface of the leaf in order to rid itself of them. Occasionally the aphid is held high in the air on the points of the mandibles for several minutes while feeding is in progress. Also if the larva is disturbed it will hold the aphid in this manner while running away.

A first instar larva will require from two and a half to three and a half hours in destroying a half grown cabbage aphid. Larvae of the third instar will destroy them in from five to fifteen minutes depending on the size of the aphid.

In addition to aphids the larvae have been found feeding on the eggs of Coccinellids and of the cabbage butterfly, also on those of their own species. Feeding on their own eggs does not usually take place if all eggs are of the same oviposition period as these hatch almost at the same time. However if two different groups of eggs are placed together the larva of the group first hatching invariably find and destroy the eggs of the second.

The larvae have only three instars. The method used in determining this point has already been described under rearing. Table I is the record of sixteen larvae that were carried from egg to adult. It includes the length of the incubation period, the length of each individual instar, and of the inactive period spent by the larva in the cocoon before the final moult to the pupal stage. Averages and totals for the table are included.

From Table I we find that the first instar averages two and a half days in length, with a maximum of four and minimum of two days. The average length of the second instar is one and a half days with a maximum and minimum of two and one respectively. The third instar is much longer averaging four and a quarter days but over half of this period is spent in spinning the cocoon and lying inactive before the final moult. The total larval period averaged slightly over eight days with nine as the maximum and seven as the minimum length.

TABLE I.—LENGTH IN DAYS OF EGG STAGE, LARVAL INSTARS, AND PUPAL PERIOD OF *Micromus posticus* WALKER

Larva number.	Egg	1st Instar	2nd Instar	3rd Instar active	and Pre pupal period	Pupa	Larval stage	Egg to adult	Preoviposition period	Egg to egg
1.	4	2	1	2	2	5	7	16		
2.	4	2	1	2	2	5	7	16		
3.	4	2	1	2	2	4	7	15		
4.	4	2	2	2	2	5	8	17		
5.	4	2	2	2	3	4	9	17	3 days	20
6.	4	2	2	2	3	4	9	17		
7.	4	3	1	1	3	5	8	17		
8.	4	2	2	1	3	5	8	17		
9.	4	2	2	1	3	5	8	17		
10.	4	3	2	1	3	5	9	18		
11.	4	3	1	2	3	3	9	16		
12.	4	3	1	2	3	3	9	16		
13.	4	3	1	2	2	4	8	16	4 "	20
14.	4	2	2	2	2	4	8	17		
15.	4	4	1	2	2	4	9	17	3 "	20
16.	4	3	1	2	2	4	8	16		
Totals	64	40	23		68	64	131			
Averages	4	2½	1½		4¼	4	8+			

Table II constitutes the feeding record of the sixteen larvae from which the data were obtained for Table I. Figures at the top of each daily square show the number of aphids available as food and those at the bottom give the number destroyed. (See next page)

The following tabular summary of Table II is given showing the average, the maximum, and the minimum number of aphids eaten in each stage.

	Ave.	Max.	Min.
First Instar	10	16	4
Second "	11	21	3
Third "	20	28	3
Total period	40	56	27

The averages show that feeding is about the same in the first two instars and that the third practically doubles these two in amount of food consumed. The small amount of food used is especially noticeable when it is compared with the larval feeding records of the Coccinellids, where averages of from one hundied to six hundred aphids destroyed are not uncommon.

After the third instar has progressed several days (see Table I) the larva spins a very loose meshed almost circular cocoon which will measure from seven to eight mm. in diameter. This will correspond roughly to the length of the larva, as it is spun without curling up. We now have a structure somewhat resembling two saucers placed together, concave surfaces joining with the larva inside. This outer cocoon is really a

TABLE II. LARVAL FEEDING.

Larva No.	Aug. 12	Aug. 13	Aug. 14	Aug. 15	Aug. 16	Aug. 17	Aug. 18	Aug. 19	Aug. 20	Aug. 21	Aug. 22	Aug. 23	Aug. 24	Aug. 25	Aug. 26	Aug. 27	Aug. 28	Aug. 29	Aug. 30	Aug. 31	Sept. 1	Sept. 2	Sept. 3	Sept. 4	Sept. 5	Sept. 6	Sept. 7	Totals	1st Instar	2nd Instar	3rd Instar
1	6 2	5 5	6 3	10 10	10 10			P																				30	7	3	20
2	5 2	8 7	6 6	11 11	18 16			P																				42	9	6	27
3	8 5	10 9	14 13	8 8	13 12			P																				47	14	13	20
4	5 5	5 4	6 5	6 5	7 7	10 9			P																			35	9	10	16
5						6 5	8 7	8 7	9 9	9 32				P														31	5	14	12
6						21 4	11 10	12 11	21 20	23 11				P														56	4	21	31
7								8 6	13 9	15 9	14 3				P													27	15	9	3
8								18 8	17 8	33 21	16 16	29 2			P													52	15	21	18
9								11 5	13 10	10 7	9 9	17 0			P													31	15	7	9
10								6 1	11 5	15 2	10 10	23 22	9 6			P												46	6	12	28
11													5 2	6 5	8 2	10 10	16 11				P							30	7	12	11
12													8 6	10 9	11 3	11 11	18 11				P							40	15	3	22
13																7 5	11 9	7 6	12 12	10 8			P					40	14	6	20
14																8 8	9 6	10 10	22 19	11 8			P					51	8	16	27
15																6 5	10 4	6 6	10 8	17 16	7 7			P				39	15	8	23
16																10 9	10 7	12 10	9 9	12 12			P					47	16	10	21
Average totals																												40	10	11	20

framework to support the inner, which is now constructed. The larva doubles or curls up and now spins an oval, much more closely meshed cocoon which may be placed either along the sides or in the center of the outer one. It will measure about 5 mm. in length by 2.5 mm. in width. The larva can be distinctly seen through both of these loose silken envelopes. Three to four hours will be used in spinning the outer case. Construction on the cocoon proper is slow and it is hard to tell exactly when work on it ceases.

The silk is spun from the anus, the larva moving the tip of the abdomen hesitatingly back and forth, up and down, and changing the position of the body frequently.

After two or three days in the cocoon the final larval moult takes place (see tables) and the pupa stage proper commences. The shriveled exuvium remains at the tip of the abdomen.

The place of pupation has not been accurately determined. It is probable however that it rarely takes place on the plant on which the larvae have found their food. Two things lead me to believe this; first, though I have constantly looked for them in the field, that is on plants, I have never found the pupa. Second, several larvae in the third instar were placed on plants infested with aphids. When ready to pupate they left the plant and pupated under some card board that was used to support the base of the "chimney" cage. It is probable therefore that the larva pupates under clods, stones or refuse or possibly in the soil.

The pupal periods for sixteen individuals are shown in Table I. The average length of time required by this group for transformation was four and a fourth days.

In emerging the pupa works its way out through one end of the cocoon and through the outer envelope, the emergence of the adult taking place on the outside or within a few mm. of the cocoon. So loosely are the two envelopes woven that the path of emergence is hard to see.

The adults are more active at dusk but may be seen flying in dense shade and on cloudy days. On bright days they are usually found resting quietly on the undersides of leaves and are not easily disturbed.

I have noted them as most abundant on herbaceous plants, such as rape, etc., and also on white pine infested with *Dilachnus strobi*. None have been observed feeding in the open. In the laboratory where adults were kept without food for several days feeding would take place during the day when aphids were given them.

The adults are practically always found on or about aphid infested plants or trees. A few have been taken early in the morning on the

outside of windows where they had evidently been attracted by the heat radiating from within.

Mating has not been observed and is evidently either a very short or a nocturnal operation. It is of interest to note that copulation does take place, as is proven by the hatching of the eggs, in such a limited space as that under an inverted petri plate.

Records of the preoviposition period were secured in three instances. Two of these were three and the other was of four days in length. The individuals making these records are shown in Table I.

The place of oviposition in both the field and the laboratory has already been discussed. The following egg-laying records were secured from females confined under petri dishes.

Table III.—Egg Records of *Micromus posticus.*

																				Totals
No. A	0	0	0	38	68	0	0	0	0	0	Dead.									106
" B	0	0	0	0	21	19	31	11	0	0	"							Dead		82
" C	0	0	0	0	18	12	42	46	21	18	3	16	3	13	34	8	6	2	0	246
																				Average 144

Table III gives a difference of from eighty-two to two hundred and forty-six eggs per female with an average of one hundred and forty-four each. The period over which the eggs were laid is of interest, in one case lasting only two days while in another it extended over two weeks. The number of eggs laid indicates that the insect has fair reproductive powers and but for weak spots at other points in the cycle would be much more common.

Observations made on the feeding of the adult seems to indicate that the rate is little higher if any than in the case of the third instar larvae where the number of aphids destroyed daily averaged about ten.

The following table deals with the length of life in the adult.

Table IV.—Length of Adult Life

Adult No......	1	2	3	4	5	6	7	8	9	10	11	12	13
Days Alive....	8	14	21	35	35	36	32	32	10	11	19	6	10

From the above we find that the average length of life was twenty-one days. All the above individuals were reared in captivity during the months of August and September. It can only be guessed that adults in the open live for a longer time but it is probable that they do.

In the spring adults have been noted on aphid infested white pine during the month of April. Table I shows that the period from egg to egg may be passed over in twenty days. If we consider the breeding season as lasting from May until October we have a possibility of four, five or even more generations. The number of generations combined with the reproductive ability of the females should produce a large

number of individuals during the course of the season. No great increase however was noted in the field.

The adults probably overwinter. In support of this supposition three adults were taken in the field about the middle of October. These were placed in an outdoor cage and fed as long as aphids were obtainable in the open. On the twentieth of December two of the adults were still alive though freezing weather had been the rule for several weeks. When next examined on Jan. 2, these two were dead. The fact that they lived for a period of over two months in the open, under winter conditions would seem to indicate that some individuals would successfully overwinter. There is also a possibility that the pupa overwinters but the extreme frailty of the case seems to be an objection to this idea.

No parasites have been reared from any stage of this species nor have any signs been noted that would indicate parasitism. As far as we have been able to find there is also freedom from disease.

Descriptions

Since this work has been completed, the egg and all immature stages of *Micromus posticus* have been described and illustrated by Dr. R. C. Smith. (See Annals of the Entomological Society of America Vol. XVI, No. 2, p. 145–146 and Plate VII). The adult was first described by Walker in "The British Museum Catalogue of Neuroptera," p. 283, 1853. Descriptions are also found in "A Synopsis of the Neuroptera of North America," p. 204, 1861, by Hagen and in "The Transactions of the American Entomological Society," Vol. XXXII, p. 45, 1906, by Banks. In this publication it is mentioned as common throughout the eastern and southern United States. It is also stated that the larvae are found usually on trees and that about ten days are required for their development.

Economic Importance

In the neighborhood of Columbus and Wooster during the past two summers this insect was of little economic importance in controlling aphids. Many counts of aphid predators taken in the field showed that in numbers this species was far in the minority. Attention may also be called to the low rate of feeding that is common to both predaceous stages. Banks ('06) states that they are common on aphid infested trees but the word common may be used by the collector in a far different sense from what it would mean if used by an economic entomologist. The number of eggs per female and the several generations per year would lead us to expect that the insect would increase rapidly during the

breeding season. This however did not seem to be the case. The adult insect is rather fragile and it is thought that storms might work considerable destruction among them. The same might also be said of the first and second instar larvae which are quite frail. It is known that the first instar larvae can not live as long without food as can Coccinellid larvae. Other factors of weakness are unknown.

Bibliography

Banks, Nathan.
1906—Transactions of the American Entomological Society, Vol. XXXII, p. 45.

Hagen.
1861—Synopsis of the Neuroptera of North America, p. 203.

Smith, R. C.
1923—Annals of the Entomological Society of America, Vol. XVI, No. 2, pp. 129–148.

Walker.
1853—British Museum Catalogue of Neuroptera, p. 283.

A VALUABLE SNAIL POISON

By A. J. Basinger, *Assistant Entomologist, California State Department of Agriculture, Sacramento, California*

Abstract

A mash made of one part calcium arsenate and sixteen parts bran was used successfully as a poison bait in eradication work against *Helix pisana* at La Jolla, California. It is now giving splendid results in the control of *Helix aspersa*.

During a campaign to eradicate a foreign snail, *Helix pisana*, that was gaining a foot-hold at La Jolla, California, we succeeded in developing a very valuable snail poison that has proven successful not only against *Helix pisana* but also against the Brown Snail, *Helix aspersa*. This is an European species of wide distribution in America and of considerable economic importance. In conducting a series of experiments to determine the best means of combating *Helix pisana* we tried a mash composed of calcium arsenate and bran which we adapted from Lovett and Black[1] who used calcium arsenate and chopped lettuce leaves in the control of slugs. The calcium arsenate and bran proved so potent a weapon against *Helix pisana* which now is practically anihilated that we attribute a large portion of our success in the campaign to this poison. *Helix aspersa* occurred also in the same areas treated for *pisana* and now it, too, is scarce in those areas. There is no doubt but that other species of snails could be controlled by the same remedy.

The poison is made up at the rate of one part of calcium arsenate by weight to sixteen parts of bran. The ingredients are thoroughly mixed dry and then water is added to make a moist but not wet mash. It

[1]Lovett and Black, The Gray Garden Slug. Oregon Agricultural College Experiment Station Bulletin No. 170, June 1920.

must be dry enough so that it will scatter nicely when tossed out with the hand. The infested areas should first be sprinkled with the garden hose, where water is available, as this brings out the snails and keeps the mash moist and palatable. It is preferable to do this in the evening. The poison bait is then broadcast over the infested areas as in sowing grain. It is desirable to toss it lightly over plants so that particles of the poison bran will lodge on the foliage as well as on the ground. The application should be followed each evening for four or five days by a wetting with the garden hose unless the work is done during rainy weather. The poison is very stable and does not loose its efficiency even after being wet each evening for a week or more. We gathered some of the dried particles of poison bran from the ground after it had been wet every evening during six days and it proved fatal to snails that fed on it. This is a slow acting poison and the results from an application should not be judged until two or three days later.

In an experimental plot we secured a kill of 96% out of 6431 active *Helix pisana* in six days. The results during our practical applications were fully as satisfactory. In a treatment applied to a flower bed infested with *Helix aspersa* 86% of a total of 588 snails were dead from the poison at the end of three days. This percentage would have been much higher had the experiment been continued two or three days longer. The following is a copy of a letter from a man in charge of an estate of about ten acres at Pasadena, California, who used the poison bait for *Helix aspersa* according to the directions given herein and was kind enough to report the results.

"Dear Sir:

The day following your visit to our place at the above address I prepared and carefully broadcasted the preparation for the extermination of snails over the entire canyon and the flower gardens. This covered the areas where the snails were the most plentiful. We followed this work during the following week with very liberal spraying over the entire area each day as much as possible and I am glad to report that the result is very gratifying. In fact it is better than I had hoped for. During the past three days I have spent my entire time in cleaning out leaves and old plants through this part of our grounds and have found hundreds of snails and out of the many hundreds only two that were alive. One was in the vegetable garden back of the house where you found the large snail that you took with you as a specimen and the other on a branch of an oak tree.

Very truly yours,
A. H. GREGORY
1504 So. Marengo Ave., Pasadena, California.

This poison bait is now being distributed in considerable quantities through the office of County Horticultural Commissioner R. R. McLean

in San Diego County, California, for the control of the Brown Snail. Being simple, inexpensive and efficient we feel that it may be used to advantage in other parts of the country and perhaps on other species of snails.

Scientific Notes

A Tingid attacking quince. In June the writer observed several quince trees, the leaves of which were noticeably injured by the feeding of Tingid nymphs and adults. The leaves were mottled with brown and in some cases almost entirely brown as a result of the feeding punctures.

Adults were submitted to Prof. C. J. Drake who identified them as *Corythucha cydoniae* Fitch.

J. R. Stear

Ormenis pruinosa Say—A Fulgorid on Apple and Peach. This Fulgorid was quite common on apple and peach in Cumberland Valley orchards this season. The white woolly nymphs clustered along the twigs resembled woolly aphids in appearance and were frequently mistaken for them. No injury was observed as a result of their feeding. Reared adults were determined for me by Prof. J. G. Sanders.

J. R. Stear
Chambersburg Laboratory, Penna. Bur. of Plant Industry

Swarms of Cotton Moths: Swarms of the cotton moth, *Alabama argillacea* Hubn., appeared in Bridgeport, Conn., September 12. According to the newspapers they were so abundant in the streets as to cause the skidding of automobiles which crushed and passed over them. Be that as it may, they fluttered over and rested upon the show windows and flew into the faces of pedestrians and automobilists. Mr. Zappe observed them resting on light posts and the walls of buildings all over the city. They literally covered the posts of the "white way" lights in Bridgeport, and he also observed them in Stamford. The moths were also present in New Haven, though much less abundant. In 1911 a similar swarm of these moths occurred in New Haven the last week in September, and in 1912 the moths also appeared, though in much smaller numbers and not until October 11 and 12.

W. E. Britton

The European Earwig in California: The writer wishes to announce the discovery on August 31, 1923, of large numbers of the European earwig, *Forficula auricularia* Linn., in West Berkeley, California. The origin of the infestation is not known but it is claimed by residents of the infested area that it has been under observation for at least four years. As yet no apparent damage has resulted from its presence and it would not have been reported had it not been for the fact that great numbers collected on the front porch of one of the residences during a vacation period. So repulsive were these to the owner that a few specimens were sent in for identification. The specimens were compared with those received from Seattle, Washington, in 1916, and proved beyond a doubt to be the European species.

The infestation has been reported to the State Department of Agriculture in view of the seriousness of the earwig menace in Oregon as reported by A. L. Lovett

in the *Oregon Grower*, August, 1923. According to Professor Lovett the earwig is a real menace to agriculture as well as a household nuisance of the first magnitude.

E. O. Essig

Scutellista cyanea **Mot. recovered at New Orleans, La.**—Those familiar with the literature of this parasite will recall that it was liberated to attack the barnacle scale, *Ceroplastes cerripediformis* Comst., at Baton Rouge, La., in 1897 by Dr. H. A. Morgan then entomologist of the Louisiana Experiment Stations. The original material was sent to Dr. Morgan from Washington, D. C., by Dr. L. O. Howard who had received it from Dr. Leonardi in Italy; and Mr. Alexander Craw in 1903 also sent to Dr. Morgan a quantity of *Saissetia oleae* Bern., parasitized by Scutellista from California.

Dr. Morgan states in correspondence with Mr. Ed. Foster of the Louisiana State Department of Agriculture and Immigration that *Scutellista cyanea* was liberated only at Baton Rouge, La., and in July of 1897. Careful searches made several years after liberation failed to reveal a single individual. It was therefore supposed to have died out, and this, its first recovery after more than twenty-five years and at a point over 110 miles distant from the place of liberation, seems very remarkable.

The rather light infestation of the black scale, *Saissetia oleae*, on *Nerium oleander* and varieties in this city, led the writers to make a short inquiry as to the part which parasites might be playing in holding this scale in check here. Accordingly, liberal quantities of oleander branches infested with black scale were collected and caged on May 4, 7, 10, and 12, at which times many exit holes could be seen in the scales; in some instances living parasitic larva and pupae could be found by removing scales at random, and one scale thus removed contained three pupae. As a result numerous parasites emerged on May 11th and on subsequent dates up until June 20th, shortly after which time the cages were discontinued due to drying of the material. These parasites were identified as *Scutellista cyanea* Mot., which identification was later confirmed by Mr. Gahan of the United States National Museum.

About 80 or 85% of the black scale on oleander in New Orleans seem to be parasitized by this insect.

H. K. Plank
Thos. F. Catchings

An Outbreak of *Amorbia humerosana* **Clem. on Apple:** A serious outbreak of the Leaf-roller, *Amorbia humerosana* Clem. has been found in York County, Pennsylvania. The species has been present in small numbers for a number of years and attention was previously called because the insect might probably become an apple pest. The writer has collected the species from apple from ten counties in Pennsylvania. It feeds also on Poison ivy, Spice bush, Pine and Huckleberry. The injuries resemble those of *Eulia velutinana* Walk. but the scars are larger and deeper. The species is one brooded, the larvae mature towards the end of August or first of September. They winter as pupae and the adults issue in April and May of the following year.

S. W. Frost, *State College, Pa.*

An Important New Pest of Beets in Porto Rico. *Disonycha laevigata* Jacoby is the determination given by Mr. G. E. Bryant, of the Imperial Bureau of Entomology, of a Chrysomelid which has recently become very abundant in Porto Rico. The beetle is about 4.5 mm. long, bright orange-red in color, with eyes, antennae except two basal segments, apical half of tibiae and all of tarsi, black and finely pubescent; the elytra bright green, shining and impunctate. Dr. E. A. Schwarz

states that there are specimens of this beetle in the National Museum collected many years ago in Jamaica. The writer first noted it feeding on the leaves of cultivated beets at Haina, Santo Domingo in 1920, and the first record in Porto Rico is feeding on the leaves of *Amaranthus* spp. at Guanica, Aug. 16, 1921. In December, 1922, a young planting of beets at Rio Piedras was entirely destroyed by these beetles, and a month later millions of them were found on the leaves of young plant cane and bean plants at Guanica. *Amaranthus* spp. are common weeds in these fields and large amounts of the normal host had been destroyed in preparing the fields for cultivated crops. The beetles were not feeding on the bean or cane leaves, merely hiding or resting on them. During the winter the beetles became very abundant about Mayaguez, attacking "beets, chard, eggplant and many other vegetables," and Prof. R. E. Danforth assigned the working out of their life-history to his advanced students in Entomology at the College of Agriculture there. In June, the writer noted a number of blackbirds, *Holoquiscalus brachypterus* (Cassin), walking about the shore of a small saline lagoon at Hatillo, and on closer examination it was found that they had presumably been attracted by the large numbers of this beetle feeding on a weed, *Philoxerus vermiculatus*, which had been defoliated and killed out over a considerable area by them.

George N. Wolcott

The Cave Cricket, Ceuthophilus, as a Possible Vector of Pathogenic Organisms. During the past summer spent at a camp on Lake May (or "Goose Pond" as it is called by the natives), near Lee, in the Berkshire Mountains of Western Massachusetts, the numerous cave crickets (Ceuthophilus) found crawling about in the open privies characteristic of the camps on the lake, attracted my attention. Since cave crickets similar to those found in the privies were observed walking over the food on pantry shelves, it occurred to me that these insects are a potential menace under camp conditions, and I have been greatly surprised to find no reference to Ceuthophilus in the rôle of a vector of pathogenic organisms, in the literature on insects and disease available to me at this time!

People in ill health frequently resort to mountain camps to recuperate, and under such conditions, it would be expected that the excreta in the privies would in some instances be contaminated with the bacilli of intestinal tuberculosis, or even of typhoid fever, and similar pathogenic organisms occurring in the digestive tract of human beings. It is quite conceivable that Ceuthophili walking over such contaminated material, and later finding their way to the kitchens and pantries near by, might readily contaminate any food over which they might crawl; and if such food were eaten uncooked, it is quite possible that infection might result, especially in persons whose resistance to disease was weakened, and who had come to the mountains in a "run down" condition, to rest and recuperate.

Since Ceuthophilus is usually a crepuscular or nocturnal wanderer, one is usually unaware of the numerous crickets prowling about his pantry shelves, and this doubtless accounts for the fact that we do not hear more about the danger of these crickets carrying disease under camp conditions. It seems to me, however, that the menace is a very real one, and the rôle of Ceuthophilus as a potential vector of pathogenic organisms under rural conditions, is a subject worthy of further investigation.

G. C. Crampton, Ph.D.,
Massachusetts Agricultural College, Amherst, Mass.

The Oriental Peach Moth (*Laspeyresia molesta* Busck.). Since the note appearing in the August number of the JOURNAL, several serious outbreaks of this pest have been found in Pennsylvania. Through the efforts of Mr. E. M. Craighead of the Niagra Sprayer Company, several serious infestations have been found in the vicinity of Collegeville, Pa. Twenty-five percent of the early varieties and sixty percent of the late varieties show injury. The injury in the latter case is so serious that it will not pay to market the fruit. Orchards in the vicinity of York, Pa. show from ten to twelve percent injury. The pest has been found in noticeable numbers in York, Adams and Franklyn counties, Pennsylvania. The larvae of the fourth generation pupate chiefly at the stem end of the fruit. Some adults issued on September 7th making preparations for the fifth generation. On the bearing trees the injury was found most serious on the fruit, while on the non-bearing trees the injury was confined to the terminal shoots.

S. W. FROST, *Pennsylvania State College.*

THIRTY-SIXTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The thirty-sixth annual meeting of the American Association of Economic Entomologists will be held at Cincinnati, Ohio, December 29, 1923 to January 2, 1924, inclusive.

Details in regard to the exact place of meeting or concerning hotel headquarters are not available at this time as final arrangements have not been completed.

The Section on Apiculture will meet at 10 A. M., Saturday, December 29. The Section on Horticultural Inspection will meet at 1.30 P. M., on the same day.

The opening session of the general association will be held at 10 A. M., Monday, December 31st. On that evening at 8 P. M., the meeting of the Insect Pest Survey and Extension Entomologists will be arranged.

Applications for membership should be filed with the Secretary as soon as possible and should be accompanied with a fee of $3.50. Blanks can be secured from the Secretary or the chairman of the membership committee.

A. F. BURGESS, *Secretary,*
Melrose Highlands, Mass.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1923

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded or the proof returned, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

One hundred separates or reprints at $2.50 per page or plate. Additional hundreds or less, 4 pages or less, $1.00; 5-8 pages, $1.50; 9-12 pages, $1.75; 13-16 pages, $2.00; 17-24 pages $3.00; 25-32 pages, $4.00. Covers suitably printed on first page only, 100 copies, or less, $4.50; additional hundreds, or less, $1.75. Plates inserted, $1.75 per hundred, or less. Folio reprints, the uncut folded pages (50 only), sixteen page signature, or less, $3.00.

A greatly depleted supply of lumber and high prices have brought all phases of the forestry problem to the front. There are highly developed systems for fire protection in some areas and large sums are being expended for reforestation. Both of these are extremely desirable, yet insects, as shown by the investigations of Dr. Hopkins, are responsible for greater losses in our forested areas than the more spectacular fires. Comparatively little has been done in the development of practical methods for reducing insect depredations in woodlands. This is something that must come in the near future and is being developed in portions of the United States and Canada, work in the latter country being stimulated largely by the extensive depredations of the spruce bud worm.

The resumé given on preceding pages of this issue is a most fitting tribute to an earlier worker. It should result not only in giving credit where credit is due but also serve to call attention to an exceedingly important and difficult line of work which should receive more attention from entomologists. The extensive planting of young trees in connection with reforestation programs is resulting in more problems, since experience has shown that certain insects are not slow to take advantage of the situation. Forest entomologists must develop methods which will make the new plantings reasonably safe from injury as well as devise means for reducing insect injury to the older growth and various forest products. Insects affecting shade and park trees have so much in common with forest insects, that the two should not be separated. It is illogical to spend large sums for fire protection of woodlands and for reforestation, both highly desirable, and allow these efforts to be nullified to a great degree by preventable insect depredations. In other words, a chain is no stronger than its weakest link. Can the entomologist aid in making a stronger chain?

Reviews

Manual of Entomology with Special Reference to Economic Entomology, by H. Maxwell Lefroy, Professor of Entomology, Imperial College of Science and Technology, pp. i–xvi, 1–541, 4 plates and 179 text figures. Price, $11.75. New York, Longmans, Green Co.: London, Edward Arnold & Co., 1923.

The author in elaborating a portion of his lecture course on economic entomology has given a general account of all groups of insects with special reference to their immature stages, biology and economic importance. He emphasizes identification, a prerequisite to efficient control in many cases. His personal acquaintance with the faunæ of temperate and tropical climates makes possible an unusually comprehensive and authoritative volume, the value of which is not lessened by occasional reference to American insects.

The treatment is upon a systematic basis and largely by groups with comparatively little attention to individual species. The discussion of the 1500 Scolytidæ or Ipidæ, for example, being limited to less than two pages. The volume is suggestive rather than exhaustive and unlike many American works, there are no extensive bibliographies, the author limiting himself to brief citations of catalogues or monographs, thus compelling the student to use such bibliographic aids as *Zoological Record, Genera Insectorum* and the *Review of Applied Entomology.*

The book is designed for use with a collection and compels actual acquaintance with insects. There are no keys for the identification of species and the relatively few illustrations simply give assistance here and there, although the salient characters are given for each group. The author recognizes 26 orders, the accounts of the Protura and Zoraptera being particularly welcome.

There are hosts of facts in this rather large, concisely written volume of much interest to entomologists throughout the world, and though primarily British, it has a much broader scope. E. P. F.

Insecticides and Fungicides, Spraying and Dusting Equipment, A Laboratory Manual with Supplementary Text Material, by O. G. Anderson and F. C. Roth, pages i–xvi, 1–349, 70 figures. John Wiley & Sons, Inc., New York, Chapman and Hall, Limited, London, 1923.

Part I of this volume is a laboratory manual on insecticides, fungicides and appliances. It consists of 172 pages devoted to laboratory exercise on insecticides, fungicides, combination sprays, miscellaneous materials, such as weed killers, whitewash and sterilization by steam, fumigants, spraying equipment and cost problems, designed to give practical experience in the preparation of materials and a good idea of the nature of spraying and dusting apparatus, citations of the more important literature being given with each exercise. It is an admirable laboratory manual.

Part II, pages 173–334, includes comprehensive accounts of methods of controlling nsects and plant diseases and extended and very practical discussions of sprayingi and dusting equipment, cost of operation and directions for operating a gas engine,—literature being freely cited.

The general reader will find much of practical value in Part II, especially orchardists. The impartial up-to-date, discussion of spraying and dusting should be extremely valuable to many large growers. We have in this volume a comprehensive, authorative discussion of numerous practical phases of pest control. The book should not only be in the hands of students, but also in all horticultural libraries and upon the shelves of most fruit growers and others more or less directly concerned in the control of insects and fungi.

Current Notes

Mr. H. G. Barber of Roselle, N. J., worked at the U. S. National Museum during the month of July.

Dr. Carl J. Drake of the Iowa State College and Station has recently recovered from a severe attack of pneumonia.

Mr. Harold C. Hallock has accepted an appointment in biological work with parasites of the Japanese beetle at Riverton, N. J.

Professor Z. P. Metcalf, Professor of Zoology and Entomology in the North Carolina State College and Entomologist of the North Carolina Experiment Station, has been appoined Director of Resident Teaching in the College of Agriculture.

Mr. S. A. Rohwer of the U. S. National Museum, recently spent a few days comparing specimens in the collections in the American Museum of Natural History, New York, and in the Philadelphia Academy of Natural Sciences.

Mr. Oliver I. Snapp of the U. S. Peach Insect Laboratory, Fort Valley, Ga., addressed the forty-seventh annual meeting of the Georgia State Horticultural Society at Cornelia, Georgia, August 23, on "Spraying Materials and Practice."

Professor J. S. Houser attended the joint summer field meeting of the Ohio and Pennsylvania State Horticultural Societies, which included an automobile tour of orchards and vegetables garden in western Pennsylvania and eastern Ohio, July 31–August 3.

A popular lecture on the subject of "Chiggers" was given by Professor T. H. Parks from the radio broadcasting station WEAO at Columbus, Ohio, August 2nd. This comprised part of an entertainment program put on by faculty of the Ohio State University

Professor W. C. O'Kane is Secretary of the New Hampshire Academy of Science. At the fourth annual meeting of the Academy, Professor J. H. Gerould read a paper on "Lethal Hereditary Factors in Butterflies."

Dr. Roland F. Hussey and his wife (Dr. Butler) have been appointed to positions in Washington Square College, a branch of the College of the City of New York. Both received the doctorate at Bussey Institution last June, and both will teach zoology.

Mr. H. S. Adair who has been assisting with plum curculio studies at the Peach Insect Laboratory of the U. S. Bureau of Entomology at Fort Valley, Ga., has been appointed Junior Entomologist in the Bureau to assist with pecan insect investigations at Thomasville, Ga.

Dr. J. Munroe, Forest Entomologist for the British Forestry Commission, and who is attending the Imperial Forestry Conference, visited the Entomological Branch, Ottawa, Can., on July 23rd, and spent a considerable part of his time with the officers in the Division of Forest Insects.

Mr. Carl Heinrich of the U. S. National Museum recently visited the collections of the American Museum of Natural History, New York, to study the Kearfott types of microlepidoptera, and also the collections at the Academy of Natural Sciences, Philadelphia, to study the Clemens types.

Dr. E. D. Ball, accompanied by Dr. A. L. Quaintance, recently visited the boll weevil station at Florence, S. C., being conducted by the Bureau of Entomology in co-operation with Clemson College. A visit was also made to the extensive plant-breeding farms of David R. Coker at Hartsville, S. C.

Mr. H. G. Crawford, Entomological Branch, Ottawa, Can., spent the week of July 10th at Arlington, Mass., consulting with D. J. Caffrey in charge of the European Corn Borer investigations for the United States Bureau. The moths were flying freely at the time of his visit and an excellent opportunity was obtained to view the conditions of the infestation.

Dr. Guy A. K. Marshall, Director of the Imperial Bureau of Entomology, London, accompanied by Dr. E. J. Butler, Director of the Bureau of Botany, spent two days in Ottawa recently. Dr. Marshall and Dr. Butler were enroute to attend the Pan-Pacific conference which is to be held during the month of August in Australia.

Mr. Harry S. Smith, formerly chief of the Bureau of Pest Control, California State Department of Agriculture, has been appointed Associate Professor of Entomology of the University of California, to have charge of beneficial insect investigations, this work having been transferred to the University by the Legislature. He will be stationed at the Citrus Experiment Station at Riverside.

The following resignations from the Bureau of Entomology have been announced; W. W. Porter, sweet potato weevil, Miss.; Guy Hughes, temporary junior entomologist, Baton Rouge, La., to become principal of the Smith-Hughes High School in Louisiana; Messrs. W. V. Reed, I. J. Condit and G. E. Riley, collaboraters, to enter commercial work; R. W. Wells, in charge of the ox-warble laboratory, Middletown N. Y., to engage in business.

Mr. E. J. Newcomer, of the Bureau of Entomology, stationed at Yakima, Washington, has been elected Vice-President of the Northwestern Association of Horticulturists, Entomologists and Plant Pathologists at its sixth annual meeting held at Boise, Idaho, July 23–26.

Professor George A. Dean, Professor of Entomology in the Kansas Agricultural College and Entomologist of the Agricultural Experiment Station, has been appointed Entomologist in charge of Cereal and Forest Insect Investigations, Bureau of Entomology, to assume his duties September 1. Acting on the advice of his physicians, Mr. W. R. Walton found it necessary to give up the heavy work connected with the administration of this office and has taken leave in order to recuperate in health. Professor Dean will devote considerable time this fall to visiting the various field laboratories engaged in cereal and forage insect investigations and will give special attention to corn borer operations, the grasshopper situation, Hessian fly work, etc.

Dr. F. C. Bishopp, in charge of the Dallas, Texas, Laboratory of the Bureau of Entomology, visited Washington on official business, late in June. On July 1 he left for Dallas, but was obliged to leave the train at Columbus, Ohio, and upon the advice of a physician underwent an operation for appendicitis at that place. He has sufficiently recovered to return to Dallas and resume his duties.

On March 1, 1923, Mr. J. C. Hamlin was promoted by the Australian Commonwealth Prickly-Pear Board to control the scientific investigations of that body. On June 23rd, Mr. Hamlin landed at Vancouver enroute to Uvalde, Texas, where he will carry out special work for his Board during the next few months. During Mr. Hamlin's absence from Australia, Mr. W. B. Alexander is Acting Officer-in-Charge of the Board's scientific work.

According to the *Official Record*, arrangements have been completed by which Alexander Znamensky, a Russian entomologist, will be employed by the Bureau of Entomology for a year to conduct investigations in southern Russia to determine whether parasites likely to be useful against the Japanese beetle can be found there and shipped to the infested areas in New Jersey. Species of beetles closely related to the Japanese beetle are known to occur in southern Russia. Mr. Znamensky will be located at Poltava or Stavropol.

Messrs. C. P. Clausen and J. L. King, who have been in Japan seeking parasites of the Japanese beetle, have been heard from since the earthquake. They were away from Yokohama, and are safe. Dr. D. T. Fullaway was also in Japan for a short time, but resigned and returned to Honolulu before the earthquake. Dr. J. F. Illingworth is also in Japan, and has not been heard from, but it is assumed that he was away from the scene of the earthquake on a collecting trip.

Transfers in the Bureau of Entomology have been announced as follows: Dr. A. D. Hopkins, formerly in charge of Forest Insect Investigations, is now to devote all of his time to research in connection with bioclimatics; on July 1, Mr. S. A. Rohwer was transferred from Forest Insect Investigations to the miscellaneous fund for duty in the U. S. National Museum; Perez Simmons and George W. Ellington from Washington, D. C., to Sligo, Md.

Professor J. G. Sanders, formerly Director of the Pennsylvania Bureau of Plant Industry, who refused to submit to heavy reductions in funds for quarantine work on Japanese beetle, potato-wart, European Corn Borer, etc., by a new Secretary of Agriculture wholly unfamiliar with the work, has left the state department and become Manager of the Spray Oil Department of the Sun Oil Company of Philadelphia, manufacturers of their new self-emulsifying spray oil.

According to *Science*, fetes began on August 6 at Millau (Aveyron) in honor of Fabre, the famous French entomologist. A monument, the work of the sculptor Malet, representing Fabre, a magnifying glass in his hand, examining an insect, was unveiled. It was actually at St. Léons that Fabre was born, but St. Léons is a little village of a few hundred inhabitants, and it was thought desirable to erect the statue in the neighboring town of Millau. Fabre is chiefly associated with Serignan, near Orange, for it was here in his garden that he pursued his entomological studies.

It is announced that one of the parasites recently introduced from Europe as an enemy of the European Corn Borer, namely *Exoristus roborator* Fab., has been recovered from the field by the collection of corn borer larvae from which the parasite has been reared. It seems extremely probable, therefore, that this species has succeeded in establishing itself in this country. The recovery of this parasite is recorded from five or six different localities.

Mr. E. G. Smyth of the Bureau of Entomology, has left Guatemala for Mexico, where he will investigate the bean beetle situation in the area between Mexico City and Vera Cruz, with especial attention to the localities in the vicinity of Jalapa and Cordova. This region is at the edge of the Mexican plateau, and it is hoped that any parasites collected in this vicinity will be more easily adapted to the climatic conditions in the southeastern portion of the United States.

In response to a request from the National Park Service, Mr. J. C. Evenden left the Forest Insect Field Station at Coeur d'Alene, Idaho, June 6, to make an examination of serious defoliation apparently caused by the spruce budworm in the vicinity of the Tower Falls and Camp Roosevelt section, Yellowstone National Park. On his return Mr. Evenden will make an examination of a Dendroctonus control project near Boise, Idaho, which is being conducted by means of logging, and also an area defoliated by the white pine butterfly. The Dendroctonus control project on the Helena National Forest was completed May 26. Approximately 500 trees were treated.

Mr. J. R. Douglass, formerly connected with the Mexican bean beetle laboratory, Bureau of Entomology, at Birmingham, Ala., has established headquarters at Estancia, N. Mex., for the study of the Mexican bean beetle under western conditions. He reports that the dry conditions which existed during the summer of 1922 and most of last winter are continuing to some extent, and the acreage of beans has been greatly reduced. Apparently the beetles are appearing from hibernation in much smaller numbers than usual—a condition which has also been reported farther south in New Mexico by Dr. Robert Middlebrook. It appears that the dry weather of last summer, together with the cutting-off of their food supply, has influenced this unusual condition.

On June 22 Miss Isabel Cooper, scientific assistant of the Williams Galapagos Expedition, brought to Washington for identification the Heterocera and Hymenoptera secured by this expedition. It is understood that the types of all the new species are to be retained for the National Collection. These collections will be studied by Mr. Schaus and Mr. Rohwer. At the same time Miss Cooper took away several thousand Lepidoptera which had been secured by William Beebe while working at the British Guiana Experiment Station. These specimens had been identified by Mr. Schaus and are being returned to the New York Zoological Society for their collections. The work at the British Guiana Experiment Station and also the work done by the William Galapagos Expedition is carried on under the direction of William Beebe, with headquarters at the New York Zoological Gardens.

On July 25th, about 25 representatives of the Federal Horticultural Board, Bureau of Entomology, and several near-by States, visited the Japanese Beetle Laboratory at Riverton, N. J., and apple and peach orchards in the vicinity. At a conference in the afternoon, C. H. Hadley and L. B. Smith explained the various phases of the

work, and remarks were made by Professors E. N. Cory, State Entomologist of Maryland, and W. J. Schoene, State Entomologist of Virginia. In addition to the laboratory staff, the following were present: Dr. A. L. Quaintance, Bureau of Entomology, Dr. K. F. Kellerman and G. B. Sudworth, Federal Horticultural Board, Washington, D. C.; Professor W. J. Schoene, Blacksburg, Va.; Professor E. N. Cory and C. C. Hamilton, College Park, Md.; Professor Wesley Webb, Dover, Del.; Professor H. E. Hodgkiss, State College, Pa.; Messrs. Frank P. Willits, John M. McKee and W. A. McCubbin, State Department of Agriculture, Harrisburg, Pa.; Dr. T. J. Headlee and H. B. Weiss, New Brunswick, N. J.

Mr. L. S. McLaine of the Entomological Branch, Ottawa, Can., returned on July 23rd from an inspection trip to western Canada. During his absence he visited the new fumigation and inspection building at Vancouver. The new station is of hollow tile construction, covered with cement, and measures fifty by one hundred feet. It contains four fumigation chambers and in addition the large inspection and packing rooms are so constructed that they can readily be used for fumigating grain and other products. Three hundred and fifty tons of grain can be treated at one time. Arrangements were made with the British Columbia authorities in regard to carrying out the new Regulations under the Destructive Insect and Pest Act. The Satin Moth situation was also looked into. The laboratories maintained by the Branch at different points were also visited. The alfalfa weevil scouting work in southern Alberta and the inspection work at Winnepeg were discussed with the officials in charge of these duties.

The following appointments have recently been announced in the Bureau of Entomology: Temporary employees, Boll weevil laboratory, Tallulah, La., Wm. C. Gideon, Jos. Nolan Harvey, Jr., Sterling B. Hendricks, L. P. Hodges, Albert L. Monroe, R. W. Necaise, Sherrill Sevier; tobacco insect laboratory, Clarksville, Tenn., L. N. Judah, Scott C. Lyon, F. C. Plummer, W. B. Weakley; screwworm substation, Uvalde, Tex., Graden Barnett, H. L. Weatherby; Mexican beetle, Birmingham, Ala.; John P. Wemple, junior entomologist, Baton Rouge, La.; temporary, boll weevil force, Florence, S. C.; E. D. Bateman, L. L. Benton, C. A. Bolt, Wm. H. Craven, G. E. Hawkins, M. B. Hoffman, J. H. Hunter, A. K. Inman, M. L. Jones, J. G. Lewis, C. Ling, K. M. Mace, T. G. Martin, M. C. Martin, R. L. Martin, A. L. McCrary, W. D. McGowan, L. G. McGraw, J. L. Nichols, D. L. Outen, S. D. Reid, T. D. Rickenbaker, Wm. J. Roberts, T. S. Smith, R. W. Moreland, J. N. Todd; John Cotton, Robert M. Fouts; Dr. Carroll G. Bull, temporarily, to do serological work in connection with the investigations of malaria mosquitoes.

A conference of entomologists concerned with the European Corn Borer problem was called to meet at the Experiment Station, Wooster, Ohio, June 29, by Director Truax of the State Department of Agriculture. Present at the conference were Director Truax, Director Williams of the Experiment Station, Dr. Herbert Osborn of Ohio State University, R. D. Faxon, chief of the State Bureau of Entomological Inspection and Quarantine; H. A. Gossard, J. S. Houser, L. L. Huber, C. R. Neiswander and C. R. Cutright of the Experiment Station. E. G. Brewer in charge of the Federal quarantine for Ohio and adjacent areas was unavoidably absent, but sent an able assistant in Mr. Fall, who outlined fully the methods and plans of the Federal Service for the coming season. All present participated in the discussion. Special praise was given to the effective clean-up campaign put on in Ashtabula County last

spring by Professor T. H. Parks and County Agent Sleeth. Mr. Huber was able to report gratifying progress at the laboratory in starting off the life-history studies and carrying through in full to date the whole experimental program outlined in the spring. Director Truax read a letter of regret from Governor Donahey that he was unable to be present. The Governor, Director Truax and Director Williams all gave assurance of their support of the work under way.

The Federal Horticultural Board held a conference at the State House, Boston, Mass., on August 17, in regard to the Federal inspection and certification of stock to be shipped out of nurseries within the gipsy moth quarantined area. Some shipments sent into other states during the past season were found infested, most of them emanating from one nursery. The speakers included Federal and State Inspectors, Commissioners of Agriculture and nurserymen. The concensus of opinion was that each nurseryman should be responsible for keeping his own nursery clean and should carry out all methods of treatment necessary to that end: that the State authorities should give inspections and advice and direct clean-up campaigns around the nurseries to aid in the work: and that Federal inspection and certification would be refused at all nurseries not granted a State certificate. The following entomologists were present: Dr. L. O. Howard, Dr. A. L. Quaintance, Dr. C. L. Marlatt, E. D. Ball, Washington, D. C.; Mr. A. F. Burgess, D. M. Rogers, J. N. Summers, C. W. Collins, H. L. Blaisdell and S. S. Crossman of the Federal gipsy moth force; Mr. R. I. Smith and L. M. Scott, Plant Quarantine Inspection Service; W. C. O'Kane, State Entomologist, Durham, N. H.; W. E. Britton, State Entomologist, New Haven, Conn.; A. E. Stene, State Entomologist, Harry Horovitz and R. A. Sheals, Assistant, Providence, R. I.; Mr. H. L. McIntyre, B. D. Van Buren and A. M. McDonald, Conservation Commissioner, Albany, N. Y.; R. H. Allen, Q. S. Lowry, George A. Smith, Dr. A. W. Gilbert, Commissioner, State Department of Agriculture, Boston, Mass.; Dr. Thomas J. Headlee, State Entomologist, New Brunswick, N. J.; Mr. C. H. Hadley, Director, Bureau of Plant Industry, Harrisburg, Pa.; George A. Dean, State Entomologist, Manhattan, Kan.

A party of Ohio Entomologists and other state and county officials visited Port Stanley, Ontario, Canada, September 7–8, to observe the corn borer damage there and to study the control methods being used against this pest by the Canadians. The party was met by the Canadian Entomologists, with whom a joint session was held the evening of September 7th. On the 8th, a field trip was made under the supervision of the Canadian Entomologists. The party crossed Lake Erie on the State Fisheries Boat, Oliver H. Perry. The following entomologists were in the party: Herbert Osborn, Columbus, Ohio, Harrison Garman, Lexington, Ky., Erle G. Brewer, Cleveland, Ohio, C. O. Larrabee, Cleveland, Ohio, T. H. Parks, Columbus, Ohio, P. A. Howell, Cleveland, Ohio, F. W. Poos, Sandusky, Ohio, Raymond C. Osburn, Columbus, Ohio, Frank N. Wallace, Indianapolis, Ind., Geo. N. Dean, Washington, D. C., W. H. Larrimer, Lafayette, Ind., J. S. Houser, Wooster, Ohio, D. M. DeLong, Columbus, Ohio, N. E. Shaw, Columbus, Ohio, Richard Faxon, Columbus, Ohio, L. L. Huber, Geneva, Ohio, C. R. Neiswander, Geneva, Ohio, H. A. Gossard, Wooster, Ohio, D. J. Caffrey, Arlington, Mass., and M. D. Leonard, Albany, New York.

Horticultural Inspection Notes

Mr. George H. Russell, who for the past year has been stationed at New Orleans, Louisiana, has temporarily taken over the work of the Federal Horticultural Board in Galveston. He will later proceed to Del Rio, Texas, to assist in the enforcement of the Board's regulations.

The Federal Horticultural Board will open the port of Astoria, Oregon, for the entry of agricultural products under permit. The work at that port will be in charge of Mr. W. H. Freeman who has had many years' experience in plant quarantine work.

Mr. Harry B. Shaw, Pathologist in Charge of the Office of the Federal Horticultural Board in New York, attended the meeting of Phytopathologists held in Geneva, New York from July 9 to 13.

Messrs. R. D. Kennedy and R. G. Cogswell and J. W. O'Brien, inspectors of the Federal Horticultural Board stationed in New York have discovered six shipments of narcissus bulbs arriving from France slightly infested with larvae of the Lesser Bulb Fly.

Mr. Horace S. Dean, a graduate of the University of Tennessee, was recently appointed Plant Quarantine Inspector with headquarters at Washington, D. C., for the purpose of assisting in the pathological inspection of imported plants and plant products. He will also assist in the sterilization studies now being conducted for the purpose of determining a satisfactory treatment of infected plant material.

Professor R. Kent Beattie, Pathologist in Charge of the Office of Foreign Plant Quarantines, is making his annual inspection, on the west coast, of plants introduced under special permit. A similar inspection is being conducted in the East by Messrs. N. Rex Hunt and J. M. R. Adams.

Mr. Roberts G. Cogswell, who has for the past three years been assisting in the inspection work at the port of New York, was recently transferred to Washington for the purpose of assisting in the examination of plant material.

Mr. Clyde P. Trotter, who is in charge of the Board's activities in Galveston, Texas, recently visited Port Arthur, Beaumont, Orange, Sabine, and Pt. Neches, Texas, to determine the number of foreign ships arriving at those ports and the possibilities of contraband materials arriving on such vessels, either as ship's stores or passengers' baggage.

At the request of Commissioner Harry D. Wilson of the Louisiana State Department of Agriculture and Immigration, a conference to discuss the present camphor scale situation was held in New Orleans on August 6. This conference was attended by state officials of Louisiana, Mississippi, Alabama, and Texas, as well as several representatives of the Bureau of Entomology and the Federal Horticultural Board. Immediately following the conference, the visitors were conducted by representatives of the Bureau of Entomology through the heavily infested portions of Audubon Park to see the work of the camphor scale and the results of experiments in its control.

The port of Detroit was recently visited by Mr. E. R. Sasscer, Entomologist in Charge, Plant Quarantine Inspection Service, Federal Horticultural Board, for the purpose of determining the advisability of placing an inspector at that port to assist the Custom officials in the enforcement of the various quarantines promulgated by

the Board. As a result of this trip, it was evident that the work at that port was not sufficiently important to warrant the placing of an inspector there permanently. Arrangements were made, therefore, with Mr. J. W. Enwright of the Bureau of Entomology to serve as a collaborator of the Board, especially during the bulb shipping season.

On August 5 a passenger arrived at New Orleans from Antwerp, Belgium, having in his baggage ten cotton samples collected from various sections of South Africa, China, and Brazil. The owner proposed to take them to Dallas, Texas and Atlanta, Georgia. Upon examination the samples were found to contain some two hundred and fifty seeds. After a full explanation of the quarantine was made, the passenger willingly consented to the destruction of the entire lot of samples.

On August 28, Mr. Ivan Shiller, an inspector of the Federal Horticultural Board located in New York, discovered that the S. S. Ponce, arriving from Porto Rico, contained 1650 bags of cotton seed for trans-shipment and export to Glasgow, Scotland. Upon examination, this seed was found to be infested with the larvae and pupae of the Pink Bollworm. Mr. Shiller supervised the unloading of the seed and the cleaning of the hold of the vessel.

Mr. L. R. Dorland, the inspector in charge of the work of the Federal Horticultural Board at Nogales, Arizona, recently visited Douglas and Naco, Arizona for the purpose of conferring with Custom and railroad officials. Incidentally, while at these ports he secured figures on the amount of foreign business conducted at those ports, and information concerning the danger of introducing plant pests in commodities arriving from Mexico.

A large amount of Italian broom corn is entering Canada through the port of Boston where it is being treated for the European Corn Borer. The work of this pest is very evident in many shipments but no living larvae have been discovered by Canadian inspectors.

Inspectors Beaulne and Cameron in Montreal, and Ryan and Gibson in Toronto, have been examining cars of Jamaica bananas, which were transhipped at Philadelphia on account of the danger of their being infested with Japanese Beetle. Large flights of this insect were reported as occurring around the docks at the time the Jamaica boat was unloading.

Apicultural Notes

The annual picnic of the Allegheny County Beekeeper's Association of Pennsylvania was scheduled to be held at West End Park, Pittsburgh, Pa., Saturday, September 8. The Secretary is Mr. A. T. Keil, Glenfield, Pa.

The annual meeting of the Alabama Beekeeper's Association was scheduled to take place in the Chamber of Commerce Auditorium, Montgomery, Ala., on Friday September 13. Mr. M. C. Berry, Hayneville, Ala., is Secretary of this Association.

A mass meeting for Ohio beekeepers was held in the Horticultural Building at the Ohio State Fair, Columbus, Ohio, on Friday, August 31. The problems connected with the eradication of American foul brood in Ohio were discussed.

Dr. A. P. Sturtevant, Apicultural Assistant in charge of Bee Disease Investigations, of the Bee Culture Laboratory of the Bureau of Entomology, has resigned to accept the position of Assistant Professor of Bacteriology at the New York Homeopathic Medical College, New York City.

Mr. Martin H. Cassidy, instructor in beekeeping at the Massachusetts Agricultural College, Amherst, Mass., and Mr. S. H. White, one of his students, attended the Wisconsin Beekeeper's Chautauqua and the dedication of the Miller Memorial Library at Madison, Wis., August 13–16. They made the trip by automobile, and returned via Medina, Ohio, visiting the apiaries and factory of the A. I. Root Company.

The Miller Memorial Library of Beekeeping was dedicated and formally turned over to the University of Wisconsin on the morning of August 17. Mr. C. P. Dadant, chairman of the Committee made the presentation address. President E. A. Birge on behalf of the University, made the address of acceptance. Other addresses were made by Mr. E. R. Root, Dr. E. F. Phillips and Mr. B. F. Kindig of the Committee, and Mr. N. E. France. This occurred at one of the most important and best attended beekeepers' conferences ever held. About one thousand volumes are already in the library and an endowment for it is being created by beekeepers who have profited by the teachings of Doctor Miller. Books and magazines are being contributed to the library by European and American beekeepers.

The members of the Maryland State Beekeeper's Association visited the Bee Culture Laboratory of the Bureau of Entomology, Washington, D. C., on July 28. Rain prevented any outdoor demonstrations, but a goodly sized crowd gathered to hear the program given by the laboratory staff. The following papers were presented: "Hourly Weight Changes of a Scale Colony" by J. I. Hambleton; "Studies of a Colony in an Observation Hive" by Bruce Lineburg; "American Foul Brood" by A. P. Sturtevant; "Language of the Bees" by Archie Shaftesbury; "A Brood-Rearing Curve" by W. J. Nolan; "Moulting of Larvae" by L. M. Bertholf; "Color of Honey" by Bernard Kurrelmeyer.

Notes on Medical Entomology

The City of Fredericton, N. B., has been carrying on a mosquito control campaign under the direction of Dr. J. D. Tothill. The spring floods left an unusual number of breeding pools in the Fredericton district and very satisfactory results were obtained through oiling.

Dr. L. O. Howard has recently published an article entitled "A Fifty-Year Sketch-History of Medical Entomology" in the Annual Report of the Smithsonian Institution for 1921, pages 565–586, 10 plates. The plates are portraits of Sir Patrick Manson, Sir Ronald Ross and Doctors A. Laveran, G. B. Grassi, A. Celli, Carlos J. Finlay, Walter Reed, J. C. Carroll, J. W. Lazear, and Howard T. Ricketts.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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Proceedings of the Eighth Annual Meeting of the Pacific Slope Branch of the American Association of Economic Entomologists

The eighth annual meeting of the Pacific Slope Branch of the American Association of Economic Entomologists was held in the Y. M. C. A. Hut, University of Southern California, Los Angeles, California, September 17–19, 1923.

The meetings were called to order at 2:30 P. M. by Acting Chairman Roy E. Campbell in the absence of H. J. Quayle. A brief business meeting was held at the opening session, followed by several papers. The symposium idea was largely followed in the discussion of the topics and visits were made to the Nicotine Dust Factory of the California Sprayer Co., Los Angeles; the State Insectary at Whittier; and the Liquid Cyanide Plant at Azusa. One session, Wednesday afternoon, September 19, was a joint meeting with the Pacific Division of the Plant Physiological Section of the Botanical Society of America, the Pacific Division of the American Phytopathological Society, and the Ecological Society of America. The meetings closed with a very enjoyable banquet held at the University Club at Los Angeles, where the chairman, R. E. Campbell, acted as toastmaster.

The largest attendance of any of the western meetings was registered, including the following members and visitors:

A. J. Basinger, Riverside, Cal.
R. Kent Beattie, Washington, D. C.
A. E. Bottel, Riverside, Cal.
J. S. Boyce, Portland, Ore.
A. A. Brock, Santa Paula, Cal.
H. E. Burke, Palo Alto, Cal.
R. E. Campbell, Alhambra, Cal.
Eubanks Carsner, Riverside, Cal.
F. R. Cole, Redlands, Cal.
H. Compere, Whittier, Cal.
J. P. Coy, San Bernardino, Cal.
Clifford T. Dodds, Santa Paula, Cal.
E. O. Essig, Berkeley, Cal.
C. K. Fisher, Alhambra, Cal.
W. E. Fisher, Alhambra, Cal.
S. E. Flanders, Saticoy, Cal.
A. J. Flebut, Lindsay, Cal.
F. H. Gates, Santa Paula, Cal.
R. D. Hartman, Palo Alto, Cal.
Frank B. Herbert, Los Gatos, Cal.

W. B. Herms, Berkeley, Cal.
J. F. Lamiman, Berkeley, Cal.
A. O. Larson, Alhambra, Cal.
Arthur C. Mason, Lindsay, Cal.
A. W. Morrill, Los Angeles, Cal.
L. S. Neville, Los Angeles, Cal.
E. R. deOng, Berkeley, Cal.
E. M. Packard, Sacramento, Cal.
D. D. Penny, Pomona, Cal.
M. E. Phillips, Fresno, Cal.
G. P. Rixford, San Francisco, Cal.
Fred P. Roullard, Fresno, Cal.
M. B. Rounds, Azusa, Cal.
H. T. Ryan, Los Angeles, Cal.
E. A. Schwing, Spreckels, Cal.
Henry H. P. Severin, Berkeley, Cal.
H. S. Smith, Riverside, Cal.
L. B. Soliman, Berkeley, Cal.
C. F. Stahl, Riverside, Cal.
H. E. Summers, Los Angeles, Cal.
W. B. Turner, Sacramento, Cal.
Theodore D. Urbans, Sacramento, Cal.
W. H. Volck, Watsonville, Cal.
Geo. P. Weldon, Ontario, Cal.
R. S. Woglum, Los Angeles, Cal.
K. L. Wolff, Los Angeles, Cal.
H. E. Woodworth, Berkeley, Cal.
W. S. Wright, San Diego, Cal.
F. H. Wymere, Berkeley, Cal.

PART I. BUSINESS SESSION

The business meeting was called to order by Acting Chairman R. E. Campbell at 2:30 P. M.

The first order of business was the report of the Secretary-Treasurer which was as follows:

REPORT OF THE SECRETARY-TREASURER
FINANCIAL STATEMENT

1923				
February 1.	On hand			$24.60
(1) March 29	Paid affiliation fee to Amer. Assn. Adv. Sci		$5.00	
(2) April 18	Paid for notices to members to Armstrong School		6.10	
	Stamped envelopes	$2.55		
	1 stencil	.20		
	24 lines @$.03	.72		
	125 copies	1.15		
	Addressing	.63		
	Stamping, folding, sealing	.85		
		$6.10		
(3) August 23	Paid for notices to members to Armstrong School		$4.70	
	110 stamped envelopes	$1.40		
	25 lines @$.05	1.25		
	Running 120 copies	1.00		
	Addressing and mailing	1.05		
		$4.70		
August 23	Total disbursements		$15.80	$24.60
August 23	Amount on hand			$8.80
March 29	Received interest			.52
August 23	Received interest			.44
September 1	On hand			9.76
September 1	Refund due from Amer. Assn. Econ. Ent		$15.80	

The following committees were then appointed by the Chairman:

Affiliation: W. B. Herms, Chairman, E. P. Van Duzee.

Nomination: E. O. Essig, Chairman, H. E. Burke, C. F. Stahl.

Auditing: H. E. Woodworth, Chairman, D. D. Penny.

Resolutions: E. M. Packard, Chairman, Henry H. P. Severin.

Membership: H. E. Burke, three years; C. W. Creel, two years; E. C. Van Dyke, one year.

It was then proposed that the office of Vice-chairman be included among the new nominations. Upon motion, this was duly carried.

The question of membership then followed concerning associate and active standings, there being considerable opposition to the associate standing because so many were never moved up into active membership as they should be.

The matter of publishing papers was then presented and discussions brought out the many difficulties that members experience in trying to get their papers published in the official journal of the society. The discussion resulted in a motion by H. S. Smith "that it be the sense of the meeting that the JOURNAL OF ECONOMIC ENTOMOLOGY be changed to a monthly and the subscription price made according." The motion was seconded by H. E. Burke and carried unanimously. The matter was then referred to the resolutions committee.

The meeting was adjourned for 15 minutes to allow the committees to formulate their reports and called to order at 4 P. M. by the chair. The reports of the committees were as follows:

NOMINATIONS

For Chairman, H. S. Smith, Riverside, Cal.

For Vice-Chairman, C. M. Packard, Sacramento, Cal.

For Secretary-Treasurer, R. E. Campbell, Alhambra, Cal.

Upon motion duly seconded the secretary was instructed to cast the ballot for the election of the nominees. Carried.

The auditing committee reported the accounts in accordance with the statement of the treasurer.

The resolutions committee offered two resolutions as follows:

Resolved: That it is the sense of this meeting that the increase in volume of publication warrants an increase in the capacity of the Journal of Economic Entomology by changing it to a monthly, and that any increased expense involved be met by increasing the subscription price.

Resolved: That a vote of thanks be extended to the University of Southern California for their hospitality in providing the Pacific Slope Branch of the American Association of Economic Entomologists with a meeting place and that the secretary forward a copy of this resolution to the University.

Both resolutions were adopted upon motions duly made, seconded and carried.

PART II. PAPERS AND DISCUSSIONS

Afternoon Session, September 17, 1923

Following the adjournment of the business session Chairman R. E. Campbell opened the regular session and called for the first paper. It was presented by Mr. Stahl as follows:

A DISCUSSION OF *EUTETTIX TENELLA* BAKER AS A CARRIER OF CURLY-TOP OF SUGAR BEETS

By C. F. Stahl, *Assistant Entomologist, Bureau of Entomology*, and Eubanks Carsner, *Pathologist, Bureau of Plant Industry.*

Abstract

Eutettix tenella when feeding, has the ability under certain conditions to produce a systemic disease, known as curly-top in the sugar beet. This ability is acquired by the insect after emerging from the egg as a result of feeding for only a short period upon a plant already diseased. After this feeding some time must elapse before the insect is able to transmit the virus to a healthy plant. This fact indicates that there may be a short incubation period for the virus in the insect. When once the ability to produce the disease is acquired there is no evidence to indicate that it is ever lost during the life of the insect. Although many insects of species other than *Eutettix tenella* have been experimented with, not one has been found that is able to transmit the virus of curly-top.

Since the announcement by Dr. E. D. Ball in 1906[1] that the beet leafhopper (*Eutettix tenella* Baker) was responsible for the disease of sugar beets known as curly-top, the problem has been the subject of practically continuous investigation. As a result of these studies, many interesting and important data concerning the relation of the insect to the disease have been obtained and reported, but up to the present time the nature of the causative agent has not been learned.

Many of the ascertained points concerning the insect and its function in transmitting the disease are suggestive and as they may be of assistance in future work conducted for the purpose of determining the causative agent for the disease, it is deemed desirable to bring together in a brief discussion some of the more important facts relating to this phase of the problem.

This jassid which inhabits the arid and semi-arid regions of the West, shows some preference for plants of the family Chenopodiaceae, and produces under certain conditions in the sugar beet a systemic disease, curly-top. Available evidence indicates that curly-top has been present in sugar beet fields in the districts inhabited by this insect from the time the beets were first planted there. This crop appears to have been selected by the insect because the plants are suitable for oviposition and food.

The ability to transmit curly-top is acquired by the insect after it has

[1]16th Ann. Rept. Agr. Coll. Utah Exp. Sta. for 1905, p. XVI.

emerged from the egg; this has been demonstrated experimentally in the laboratory as well as by field observations. Nymphs which were removed immediately after hatching from diseased plants and before they had fed on them, were placed on healthy plants and in no case were they able to produce the disease. After feeding on an infected plant, however, they were able to transmit the disorder. Important additional evidence bearing on this phase has been obtained in the field. It is often possible to find in cultivated areas and in beet fields in the spring large numbers of adults of this insect which will not produce the disease. Fields heavily infested by this jassid have been noted in which the disease was either absent or present only in scattered cases. These facts suggest strongly that the leafhopper is normally unable to produce the malady and that there must be a source, continuous from year to year, from which the virus can be obtained.

No evidence has yet been gained to support a theory that this acquired ability is of any advantage to the insect.

When a nonviriferous insect, i. e., one which does not carry the virus, is allowed to feed upon a plant affected with curly-top, in our experiments it invariably becomes able to transmit the disease to healthy plants. The length of the feeding period required for the insect to obtain the virus is evidently very short. Reports regarding this point vary, intervals as short as one or two minutes having been indicated as sufficient in some instances. The writers have produced curly-top in healthy plants with insects which had fed on diseased plants for 10 minutes only.

After feeding, a short interval apparently must elapse before the virus can be transmitted to a healthy plant and produce disease, four to six hours under high temperatures having been reported. The writers have been able to secure such a transmission of the disease by means of *Eutettix tenella* within a period of 15 hours after the insect had fed on a diseased beet plant. It has been noted that at least for a certain period, a higher percentage of insects is able to produce the disease as the length of the interval between feeding and inoculation increases. The increase in number is greatest during the interval between 24 and 72 hours. The evidence available at the present time, therefore, indicates that the transmission is not mechanical, that is, simply by the contamination of the mouthparts.

When the insect is able to transmit the virus of curly-top, only a short feeding period on the healthy plant is necessary. A period of 5 minutes has been reported as sufficient for transmission but the minimum

period noted by the writers has been 20 minute for sugar beets and 10 minutes for chickweed (*Stellaria media*). This indicates that only a small amount of virus may produce a typical case of curly-top. It has been reported that the larger the number of leafhoppers feeding on a plant, the more rapid the development of the disease. This statement is contrary to the experience of the writers who have demonstrated many times that a single individual of this species, either nymph or adult, will not only produce as serious a case of curly-top as will a large number on a single plant, but also there is no difference in the rate of development of the disease.

When once the insect is able to produce the disease, this ability is apparently never lost. Evidence to support this statement has been obtained by keeping individuals known to be viriferous on plants from which the virus has never been obtained and determining from time to time whether or not they were capable of producing the disease. In view of this finding, it is probable that hibernating adults might retain the ability of the virus transmission throughout the winter. This point, however, has not been tested by the writers. It is also known that nymphs do not lose the disease-producing ability during the molting process. There is apparently no evidence to support the theory that the nymph is more virulent than the adult.

An interesting fact encountered in the problem is the apparent inability of any species other than *Eutettix tenella* to transmit the disease. Although this possibility has been assumed for a number of years, little mention has been made of it in the literature. The writers have tested several species of insects from time to time and during the past season tests have been conducted with species commonly collected on sugar beets and related plants. In all cases the insects were forced to feed for some time on beets badly affected with curly-top. From these diseased plants they were transferred to young healthy beet plants growing under conditions especially favorable for the development of the disease. From one to five individuals were confined on a plant. These tests are still in progress but thus far all results have been negative.

The following is a partial list of the species tested:

Species Tested	No. tested
Cicadula sexnotata Fall	17
Lygus pratensis L	12
Nysius sp	10
Systena taeniata Say	6
Eutettix strobi Fitch	6
Thamnotettix montanus Van D	5
Thamnotettix geminatus Van D	6

Empoasca sp	60
Agallia spp	71

Undetermined aphids found on diseased beets have been transferred to healthy plants on many occasions but without producing the disease. If, as now appears, no species of insect other than *Eutettix tenella* can transmit curly-top, some explanation of the peculiar adaptation in this case should be sought by further investigation.

The paper was then discussed by Mr. E. Carsner, H. H. P. Severin, C. F. Stahl and other members.

Chairman R. E. Campbell then called for the next paper on the program.

INVESTIGATIONS OF BEET LEAFHOPPER (*EUTETTIX TENELLA* BAKER) IN SALINAS VALLEY OF CALIFORNIA

By Henry H. P. Severin, Ph.D., *California Agricultural Experiment Station.*

Abstract

The multiplication of the beet leafhopper (*Eutettix tenella* Baker) in the Salinas Valley occurs chiefly on sugar beets. The nymphs were bred from eggs deposited in seventeen weeds growing in the cultivated areas. There was no evidence to show that a migration occurs from the San Joaquin into the Salinas Valley through the Coalinga-King City mountain pass. During the autumn dispersal the overwintering adults fly to the foothills, following the Salinas River and its tributaries.

Early planting of sugar beets (December to February) is the only known practical method of preventing losses from curly leaf in localities outside of the fog belt. In the fog belt districts late planted beets make a better tonnage than early plantings in a normal season of rainfall. Planting should be discontinued from March 1, until after the spring dispersal. The limit of beet growing in the fog belt as far as curly leaf is concerned varies from 20 to 30 miles in California.

I. Location and Boundaries

The Salinas Valley is the largest of the many valleys inclosed within the Coast Range in California. From Monterey Bay it extends in a southeasterly direction, in a line parallel with the coast, to its head—a distance of about 100 miles. Its average width is from 7 to 9 miles. Upon the northwest the valley is bounded by Monterey Bay; upon its sides by the Sierra Santa Lucia and Sierra Salinas ranges, with their outlying spurs upon the west; and by the Gabilan and Mount Diablo ranges upon the east, the latter separating the Salinas Valley from the San Joaquin Valley of the interior of the State.

II. Introduction

Ball (1) believes that the beet leafhopper migrates from the San Joaquin into the Salinas Valley. He found the leafhoppers "breeding in abundance on the native Atriplex in the Tulare region. This district

extends down as far as Bakersfield . . . . In the Salinas Valley, King City is the nearest beet growing point to this region, and is in direct line of air drainage between Monterey Bay and the low pass over into the interior."

According to Ball (1) "curly leaf rarely appears in the region along the coast, where fogs are prevalent, but as one passes to the interior points it becomes more frequent and seems to be somewhat proportional to the temperature encountered . . . . Except in periods of abundance the beet leafhopper is not found in the region along the coast from San Francisco south to the Mexican border."

III. Favorable Breeding Plants in Cultivated Areas

In the Salinas Valley annual saltbushes are scarce and the multiplication of the pest occurs chiefly on sugar beets. The beet leafhopper has been bred from the following plants growing in the cultivated areas of the valley:

Plants in Which Beet Leafhopper Deposited Eggs in Cultivated Areas of Salinas Valley.

Chenopodiaceae.

Annual Saltbushes.

1. Silverscale or Fog Weed (*Atriplex argentea*). Native.
2. Bractscale (*Atriplex bracteosa*). Native.
3. Redscale or Red Orache (*Atriplex rosea*). Introduced from Europe.

Perennial Saltbushes.

4. Australian Saltbush (*Atriplex semibaccata*). Introduced from Australia.

Pigweeds.

5. Pigweed or Lamb's Quarters (*Chenopodium album*). Common European weed.
6. Nettle Leaf Goosefoot (*Chenopodium murale*). Naturalized from Europe.

Weeds.

7. Russian Thistle (*Salsola kali tenuifolia*). Introduced from Asia.

Plants From Other Families

8. Curly Dock (*Rumex crispus*). Naturalized from Europe.
9. Rough Pigweed (*Amaranthus retroflexus*). Introduced from tropical America.
10. Tumble Weed (*Amaranthus graecizans*). Naturalized from tropical America.
11. *Amaranthus deflexus*. Introduced from southern Europe.
12. Wild Radish (*Raphanus sativus*). Naturalized from Europe.
13. Chinese Pusley (*Heliotropium curassavicum*). Widely distributed in the East and in South America and the Old World.
14. Common Horehound (*Marrubium vulgare*). Naturalized from Europe.
15. Tolguacha or Jimson Weed (*Datura meteloides*). Texas to California and adjacent Mexico.
16. Black Nightshade (*Solanum nigrum douglasii*). Native of Europe.
17. Spiny Clothbur (*Xanthium spinosum*). Native of Europe? Naturalized from Tropical America? Introduced from Chili?

IV. Spring Dispersal

During the period 1918–1923, investigations in the Gabilan and Mount Diablo ranges conducted by Mr. W. W. Thomas, Mr. E. A. Schwing and the writer, have failed to show any evidence, whatsoever, that a

migration of the beet leafhopper occurs from the San Joaquin Valley into the Salinas Valley through the Coalinga-King City mountain pass. There was no evidence to show that an enormous congregation of the insects occurs on the east side of this mountain pass during the spring. Wherever annual saltbushes grow in the mountain passes along roadsides, or covering alkali sinks, leafhoppers may be taken, which congregated on these plants after the pasture vegetation became dry on the foothills. The general distribution of the hoppers on annual Atriplexes in the mountain passes indicates that these insects have a keen sense of smell. Those leafhoppers which assemble on favorable food and breeding plants during the spring flights remain in the cultivated foothill regions together with the later summer generations.

During the period 1918–1921, the first appearance of the pale green spring brood adults in the cultivated areas of the Salinas and San Joaquin Valley occurred as follows:

Salinas Valley	San Joaquin Valley
1918 May 8, King City	1918 April 24, upper.
1919 April 22, King City	1919 April 8, 14, 28, upper, middle, lower.
1920 April 22 or 23, King City	1920 April 23, upper.
1921 April 25 to 30, King City	1921 April 6, 14, upper, middle.

V. Autumn Dispersal

During 1918, the first indication of an autumn dispersal of the dark overwintering adults occurred on October 11 to 13, in a mountain pass at Bitterwater about 15 miles northeast of King City. The insects had left the dried Redscale or Red Orache but some of the hoppers were still present on partly green Silverscale or Fog Weed growing in a large alkali sink. A congregation of adults had occurred on green pasture vegetation growing at the base of the foothills adjacent to the alkali sink. The movement of the dark overwintering adults from the alkali sink was not toward the San Joaquin Valley but in the opposite direction.

During the autumn dispersal in the Salinas Valley the dark overwintering adults were rarely taken on Red Stem Filaree (*Erodium cicutarium*) growing on the foothills within the fog belt. The leafhoppers, however, were captured more abundantly outside of the fog belt between Greenfield and King City and were far more numerous on the northeastern than on the southwestern foothills of the Gabilan and Sierra Santa Lucia ranges respectively.

During the autumn of 1919, large numbers of dark overwintering adults disappeared from the experimental field at King City on November 21. After the beets are topped large numbers of nymphs probably succumb in a dry autumn unless they are able to obtain food from

green plants growing along irrigation and drainage canals and roadsides.

During October and November 1920, Mr. E. A. Schwing discovered the dark overwintering adults on perennials growing along the Salinas River and its tributaries flowing from the Coast Range. As soon as the pasture vegetation germinated most of the leafhoppers left the perennials and were found on Red Stem Filaree growing on the foothills.

During the autumn of 1921, Schwing and the writer again found the dark overwintering adults commonly on perennials growing along the stream-ways of the Salinas River and its tributaries. In the fog belt leafhoppers were rarely taken on perennials but in the interior specimens were commonly captured on Creek Senecio (*Senecio douglasii*) and *Lepidospartum squamatum*. During the morning the bugs were sluggish and inactive and some were found below the bushes on the sand among the roots, fallen twigs and leaves. At sunset a few specimens were attracted to the wind-shield of the automobile and mating was observed. Wherever the two species of perennials were swept with an insect-net from the entrance to about 10 miles up some of the canyons, the hoppers were obtained.

VI. Curly Leaf

After the autumn dispersal of the dark overwintering adults to the foothills has occurred, the cultivated areas are not entirely free from beet leafhoppers during the winter, and these stragglers when abundant are a serious menace to early planted sugar beets. During 1918, heavy September rains fell in the Salinas Valley germinating the seeds of the pasture vegetation on the foothills and a new growth of vegetation developed in the cultivated regions. During November and December, nymphs were taken on vegetation growing along roadsides adjacent to fields in which beets had been harvested. Nymphs which hatched from eggs deposited by the summer brood adults in Red Stem Filaree were also taken on the foothills at King City. These nymphs acquired the winged stage after the autumn flights had occurred and the adults invaded the early planted beet fields adjacent to the foothills. In the upper Salinas Valley over one-half of the crop showed curly leaf symptoms before the spring brood flew into the beet fields on April 22 or 23, 1919. During a dry autumn when annual plants are mostly dry along roadsides, the number of nymphs can be greatly reduced by removing green vegetation along irrigation and drainage canals in beet fields.

VII. Early Planting of Sugar Beets Outside of Fog Belt

Early planting of sugar beets is the only known practical method of

preventing serious losses from curly leaf in localities outside of the fog belt. The fact that the adults leave the cultivated areas in the autumn has an important bearing with reference to the time of planting beets. In a dry autumn it is necessary to pre-irrigate the soil. In the Salinas Valley the adobe soil becomes very sticky when wet, and it is practically impossible to work the soil after the rainy season begins. Beets should not be planted until the end of November outside of the fog belt between Soledad and King City.

VIII. Fog Belt

Ball (1) in discussing the time of appearance of swarms of beet leafhoppers states that flights have occurred in the Salinas Valley "at different seasons and apparently in some instances at different times in the same season." During the past six years large numbers of spring brood adults invaded the fog belt of the Salinas Valley during 1919, 1921 and 1922. The leafhoppers were distributed in all beet districts of the valley on the dates given under spring dispersal. The spring invasion of the first brood into the fog belt probably depends upon the absence of fog at dusk when the flights occur. During 1918, 1920 and 1923, the fog belt was not entirely free from leafhoppers, although greatly reduced in numbers.

IX. Late Planting of Sugar Beets in Fog Belt

According to Schwing and Hartung (2), "in the fog belt districts more leafhoppers were present and a higher percentage of curly leaf occurred in early planted beet fields than in fields planted after the invasion of the pest had occurred in the Salinas Valley." At Santa Rita, about eight miles from the Pacific Ocean, 60 per cent of the early planted beets were blighted compared with 3 per cent in an area replanted on account of the disease in the same field. March plantings showed 80 per cent curly leaf on July 23, near Chualar, about 20 miles from the ocean, while beet seeds which germinated after May 1, showed only 3 per cent blight on August 5. The same condition occurred in the San Juan Valley; where, on one side of the river, March and April plantings were destroyed by curly leaf; while, on the opposite side of the river, late plantings produced a good crop.

It is evident that the date of planting has been the cause of curly leaf trouble in the fog belt of the Salinas Valley. Planting should be discontinued from March 1, until after the spring dispersal from Gonzales to Monterey Bay. In the fog belt from Chualar to Monterey Bay the soil is usually too wet and the weather too cold and foggy to plant early.

A few quotations from Ball (1) with reference to the absence of curly leaf in late plantings in the fog belt in connection with past outbreaks of the beet leafhopper corroborate the same fact observed in 1921. In 1906, "a planting made late in May did not blight while others did . . . . ." In 1906, "plantings made May 22 and 31, at Soledad and June 3, at Spreckles did not show much blight while all earlier ones in these localities did."

The question has repeatedly been asked, why is it that late planted beets made a better tonnage than early plantings in the fog belt. The answer to this question involves the proper interpretation of some of the facts concerning the life history of the beet leafhopper. In the fog belt of the Salinas Valley, Stahl's (3) "experiments conducted at Spreckels, California, demonstrated that there were unquestionably two generations annually in that locality." When the pale green spring brood adults invade the cultivated areas, most of the specimens were found to be females. There are no flights associated with mating in the beet fields as the pairing of the sexes occurs on the foothills where most of the males remain and die. In the beet fields the females at the egg-laying stage make short flights for the purpose of disseminating the eggs. It is these females of the first generation and the nymphs of the second brood which cause a high percentage of curly leaf in March and April plantings in the fog belt.

Investigations conducted in the fog belt of San Luis Obispo, Santa Barbara, Ventura, Los Angeles and Orange counties, showed that the second brood was greatly reduced in numbers when compared with the first generation. During the serious 1919 outbreak of the beet leafhopper a letter dated September 10, was received stating that swarms of hoppers were flying from beets when disturbed by the beet puller and another report that the horses became covered with leafhoppers during the harvesting of the crop in the fog belt of San Luis Obispo and Santa Barbara counties. These reports were not exaggerated but the leafhopper proved to be *Empoasca viridescens.* A week was spent in estimating the percentages of curly leaf in all of the beet fields and from 6 to 92 per cent of the beets showed curly leaf symptoms. The beet leafhopper was extremely scarce, however, in fact, in most of the fields within the fog belt it was impossible to find a single specimen. The percentage of curly leaf was entirely out of proportion to the number of *E. tenella* present on September 19 to 25. It was found in the fog belt of these two counties that the adults had succumbed to a fungus disease. An examination of the lower surface of the leaves of a single sugar beet

showed 178 dead Jassids, including the beet leafhopper, which had died as a result of a fungus disease. In regions outside of the fog belt, however, no dead fungus diseased insects were found, and near Los Alomos, nymphs and adults were abundant in the badly blighted beet fields.

In the Salinas Valley, no dead fungus diseased leafhoppers have been found in the fog belt and there are other factors which reduce the numbers of the second generation. The summer brood hoppers, however, gradually increase in numbers toward Gonzales, situated near the limit of the fog belt. In Berkeley it was frequently observed that nymphs upon hatching out-of-doors in cages failed to extricate themselves from the eggs and died in a day or two. A high mortality of the nymphs occurs in the fog belt of California, depending upon the distance from the ocean. The nymphs of the second brood do not acquire the winged stage until autumn. Movements associated with mating of the second generation occur at a time when the beets are large enough to withstand the attacks of the leafhoppers. Such factors as a late developing second brood and this generation greatly reduced in numbers, make it possible to grow a crop of beets in the fog belt of the Salinas Valley when planting is delayed until after the spring dispersal of the beet leafhoppers has occurred. The limit of beet growing in the fog belt as far as curly leaf is concerned varies from 20 to 30 miles in California.

X. Bibliography

1. Ball, E. D., 1917. The Beet Leafhopper and the Curly Leaf Disease that It Transmits. Utah Agr. Exp. Sta., Bul. 155, pp. 1–56.
2. Schwing, E. A. and Hartung, W. J., 1922. Utilization of Systematic Observations on Beet Leafhopper (*Eutettix tenella* Baker) and Curly Leaf of Sugar Beets. Jour. Econ. Ent. XV, No. 5, pp. 365–368.
3. Stahl, C. F., 1920. Studies on the Life History and Habits of the Beet Leafhopper. Jour. Agr. Res. XX, No. 4, pp. 245–252.

The papers were fully discussed by the author, C. F. Stahl, E. Carsner and many of the members.

Following announcements concerning the excursion on Tuesday afternoon and the banquet on Wednesday night, the chairman adjourned the meeting until the following morning.

Morning Session, September 18, 1923

The meeting was called to order by Acting chairman R. E. Campbell who announced that because of the serious fire in Berkeley many of the Berkeley delegates, including the secretary, had returned to Berkeley on the night train.

Mr. A. O. Larson was elected temporary secretary and furnished the following reports.

Chairman R. E. Campbell announced that there would be a dinner for the members and an excursion to the plants of the California Sprayer Co., Los Angeles, and the American Cyanamid Co. at Azusa, and also to the State Insectary at Whittier.

Chairman R. E. Campbell: We will now take up the regular program of the day, beginning with the symposium on dusting. The first paper is by Mr. E. R. deOng who has returned to Berkeley. It will be read by Mr. J. F. Lamiman.

THE RELATION BETWEEN THE VOLATILITY AND TOXICITY OF NICOTINE IN SPRAYS AND DUSTS

By E. R. deOng, *University of California*

Abstract

Free nicotine is very volatile, while nicotine sulfate is nonvolatile. The toxicity of nicotine solutions varies in proportion to their conversion from the salt form to the free alkaloid. The volatilization curve of nicotine is almost an exact parallel of the curve of toxicity both of fumigation and spraying. Dust carriers follow this same law, i. e., an inert material does not free the nicotine as does an active carrier and, hence, is less efficient.

The efficiency of nicotine sulfate sprays frequently shows marked variation especially when combined with different types of spreaders. We now know that the alkalinity of the water used as a carrier has a great influence on the value of the spray. Such differences must be even more marked when dust carriers are substituted for water, because of the extreme variability of the chemical nature and the physical action of the dusts used as carriers.

Nicotine in the free state (levorotatory) is readily volatilized and is much more toxic in this stage than when combined with acids (dextrorotatory) to form non-volatile salts. Hence, the commercial forms of nicotine sulfate are much less toxic than when the alkaloid is freed from the combining acid. Death from nicotine poisoning is the result of a fumigating action, the curve of which is very close to that from spraying as will be shown later. This is in harmony with the work of McIndoo, Thatcher and others and goes to prove that nicotine is a tracheal or "respiratory" insecticide rather than a true contact spray. Exceptions to this are found in the treatment of caterpillars where nicotine may be ingested by the mouth.

Commercial applications of the less toxic form of nicotine sulfate are usually made on the assumption, providing any thought is given to it at all, that the water used as a carrier was sufficiently alkaline to free

the nicotine from the combining acid. The addition of soap, ostensibly as a spreader, has a double value for besides its film-forming value, it increases the alkalinity of the solution. In our experimental work, however, it was found that tap water, slightly above the average of hardness and requiring 1.3 cc. of n/50 sulfuric acid to neutralize 100 cc., did not give the fullest toxicity possible even with the addition of soap. An increase in efficiency of from twenty to forty percent occurred in solutions where sufficient alkali was added over those which were neutral. Such results were secured both in spraying and fumigating and in volatilizing experiments.

Experimental

Nicotine solutions, made with free nicotine and with nicotine sulfate with varying degrees of alkalinity and in tap water, were compared in three ways: (1) Rate of volatilization as a film on leaf surfaces and from solutions, (2) Efficiency as a spray on aphids, (3) Efficiency as a fumigant on aphids.

Volatilization Experiments. The nicotine solutions used in this as well as in the spraying and fumigating experiments were, with the

Table I. Foliage Tests of the Volatility of Nicotine in Various Alkaline Solutions and Under Contrasting Meteorological Conditions

A. Laboratory Tests in clear weather.
B. Laboratory Tests in cloudy, rainy weather.
Series (1) Nicotine residue determined after three hours.
Series (2) Nicotine residue determined after twenty-four hours.
Series (3) Nicotine residue determined after forty-eight hours.

A Clear weather

No.	Type of Solution	*Percent of Nicotine Recovered* Ser. (1)	Ser. (2)	Ser. (3)
1	Nicotine sulfate, no alkali	48.5	29.9	trace
2	Nicotine sulfate+.25 cc. n/1 NaOH	50.0	25.1	4.8
3	Nicotine sulfate+.5 cc. n/1 NaOH	42.7	13.7	trace
4	Nicotine sulfate in tap water	51.5	15.7	trace
5	Nicotine sulfate in tap water plus soap equal to 4 lbs per 100 gallons	36.6	8.9	3.0
6	Nicotine sulfate+.75 cc. n/1 NaOH	27.9	trace	trace
7	Nicotine sulfate+1.0 cc. n/1 NaOH	10.4	trace	0
8	Free nicotine+.013 gm. Na_2SO_4	14.1	0	0
B	Cloudy and rainy weather			
1	Descriptive matter as above	82.6	46.1	13.4
2		52.7	18.5	7.0
3		26.9	7.7	6.0
4		35.8	12.5	19.0
5		33.2	7.4	0
6		15.5	trace	trace
7		17.9	0	trace
8		41.9	trace	2.7

exception of number 2, a nicotine sulfate solution made in the laboratory from pure nicotine combined with standard sulfuric acid to neutrality with phenolred. One cc. of this solution equaled .166 gm. nicotine. Number 1 was a neutral solution of nicotine sulfate in distilled water. Numbers 2, 3, 6 and 8 were four graduations of the ncessary amount of alkali necessary to equalize the combining acid. Numbers 4 and 5 are the same as number 1 except in the use of tap water and of soap. One and two-tenths cc. of each solution were made up to 5 cc. and applied with an atomizer to a large leaf, and after definite periods of time the remaining nicotine was washed off and the amount determined. The final test was made in an open laboratory, where the air had free circulation but where precipitation during the experiment could not wash off the nicotine. The leaves while fresh were suspended from a cord and the spray applied to the surface. Field tests on living plants gave similar results to these but attempts to get comparative data with low and high humidity were impractical on account of slight precipitation.

The data[1] on volatilization are given in Table I, in which will be found a comparison of the loss of nicotine in clear weather with a low humidity and rainy weather with high relative humidity. From this data, it will be seen that there is a marked difference between the volatility rate in clear and rainy weather. This is due in part to the slower evaporation rate of water during high atmospheric humidity, thus holding the nicotine longer in solution and hindering its volatilization. It is also possible that nicotine volatilizes more rapidly from the dry film in low atmospheric humidity. The difference in volatility between free (levorotatory) nicotine and the salt form (dextrorotatory) is very marked. The former after 24 hours has volatilized to the extent that only traces are found even by very delicate chemical tests, the range of recovery for the latter being from 29.9 to 46.1 per cent. This proves that the full amount of nicotine from a properly made spray is released in 24 hours and that from 85 to 90 per cent is available in the first three hours during clear weather, while the alkaloid combined with an acid may lack from 13 to 19 per cent of being volatilized after 48 hours of cloudy weather. Such long periods required for activation necessarily reduce the efficiency of a spray in two ways: the concentration of nicotine released may not be high enough at any one time to become

[1]All nicotine determinations were made by the silicotungstic acid method as reported by Chapin, U. S. Department of Agriculture, Bureau of Animal Industry, Bul. 133.

toxic, or rain may wash off an application or dilute it to a point of inefficiency.

It should be noted that a reduction in the amount of nicotine in solutions recovered from sprayed leaves is not necessarily due alone to volatilization but probably includes oxidation into other compounds. Nicotine oxidizes readily, turning brown when exposed to air. Under the action of oxidizing agents it yields a different product. The oxidation of nicotine seems to occur only when exposed to large quantities of air or over a considerable period of time. For example, in aspirating two to four hundred liters of air through a nicotine solution, and where the volatile nicotine passed through two or three feet of rubber tubing, it was only in rare cases that even a trace of nicotine was recovered in the washing liquid, but a close correlation was found between the amount of volatile nicotine recovered with damp silicotungstic paper, at the top of the tube, and that remaining in solution at the bottom of a short, closed, glass tube. This shows that the nicotine from a dust or spray that is in close proximity to the body of an insect would enter the tracheae unchanged but as the nicotine dissipates in the air it is soon oxidized.

Spraying Experiments. Nicotine solutions with varying alkalinity were used as in Table I., but at dilutions of one to one thousand. This concentration was chosen rather than a stronger one as complete mortality was not desired in any of the experiments. Concentration of one to eight hundred gave one hundred per cent efficiency on certain species of aphids with numbers 7 and 8. A neutral solution of nicotine sulfate was used which had been prepared in the laboratory as was also the free nicotine used in number 8. The latter contained an amount of sodium sulfate equivalent to that formed in number 7 by the addition of the neutralizing sodium hydroxide. Distilled water was used in all cases except as noted. The spray was applied by means of an atomizer. Two counts were found necessary as a twenty-four-hour exposure did not give the full effect of the nicotine.

A close correlation is noted in the percentage of mortality between those containing free nicotine (numbers 7 and 8), the latter by reason of the neutralizing alkali added. The lowest efficiency was noted in the nicotine sulfate (dextrorotatory nicotine) solution, thus proving that volatility is a primary factor in the toxicity of nicotine. The results in numbers 4 and 5 show the danger of depending entirely on natural alkalinity or the variable amount found in soap, for releasing all the nicotine.

Fumigation Experiments. The same solutions were used in this as in the spraying tests, the difference being alone in the method of application. Five cc. of each solution were placed at the bottom of a glass cylinder one and one-half inches in diameter and six inches high. Infested leaves were placed inside the upper end of the cylinder, about four inches from the solution. The upper end of the cylinder was then closed with a cork. Exposure was for the same length of time as in spraying. The data given in Table II show a close correlation between the effect of spraying and fumigating,—further proof of the relation between volatility and toxicity, and also that nicotine is a tracheal rather than a true contact insecticide.

Table II. Toxicity to Aphids[2] from Spraying and From Fumigating with Nicotine Sulfate in Solutions of Varying Alkalinity

No.	p H value	Nature of Solution	*Percent. of Aphids dead*	
			Spraying	Fumigation
1	6.5	Nicotine as sulfate, 1–1000, distilled water	53.6	48.1
2	6.7	Nicotine as sulfate, 1–1000 plus 2.4 cc. n/1 NaOH, in distilled water	49.7	55.5
3	7.2	Nicotine as sulfate, 1–1000 plus 4.8 cc. n/1 NaOH, in distilled water	60.9	58.9
4	7.4	Nicotine as sulfate, 1–1000 in tap water	51.0	62.9
5	7.6	Nicotine as sulfate, 1–1000 in tap water plus soap at the rate of 4 lbs per 100 gals.	65.3	66.6
6	7.8	Nicotine as sulfate, 1–1000 plus 7.2 cc. n/1 NaOH, in distilled water	65.4	88.4
7	7.9	Nicotine (free) 1–1000, plus an amount of sodium sulfate equivalent to that formed in No. 6, in distilled water	74.6	82.9
8	8.2	Nicotine as sulfate, 1–1000 plus 9.6 cc. n/1 NaOH, in distilled water	76.5	75.7
Check		Untreated aphids	7.7	22.3

[2]Ivy aphid (*Aphis hederae* Kalt.). Green peach aphid (*Rhopalosiphum persicae* Sulzer).

Summary. The graph shows the similarity between the loss of nicotine as determined chemically in the volatilization tests and the bio-assays in fumigating and spraying experiments. These curves are averages of from two to four series, where the same type of solutions have been tested in slightly different ways or on different species of aphids. Larger series would show more regularity in the curves but sufficient work has been done to prove the correlation between volatility and toxicity. This also shows the value of a slight addition of alkali to solutions of nicotine salts to supplement the alkalinity of the tap water, which in most instances is insuffiicent for freeing the nicotine from combining acids. The use of free nicotine, of course, obviates the

need of such addition but this form of nicotine in the concentrate is much more dangerous to handle and is subject to greater losses in evaporation.

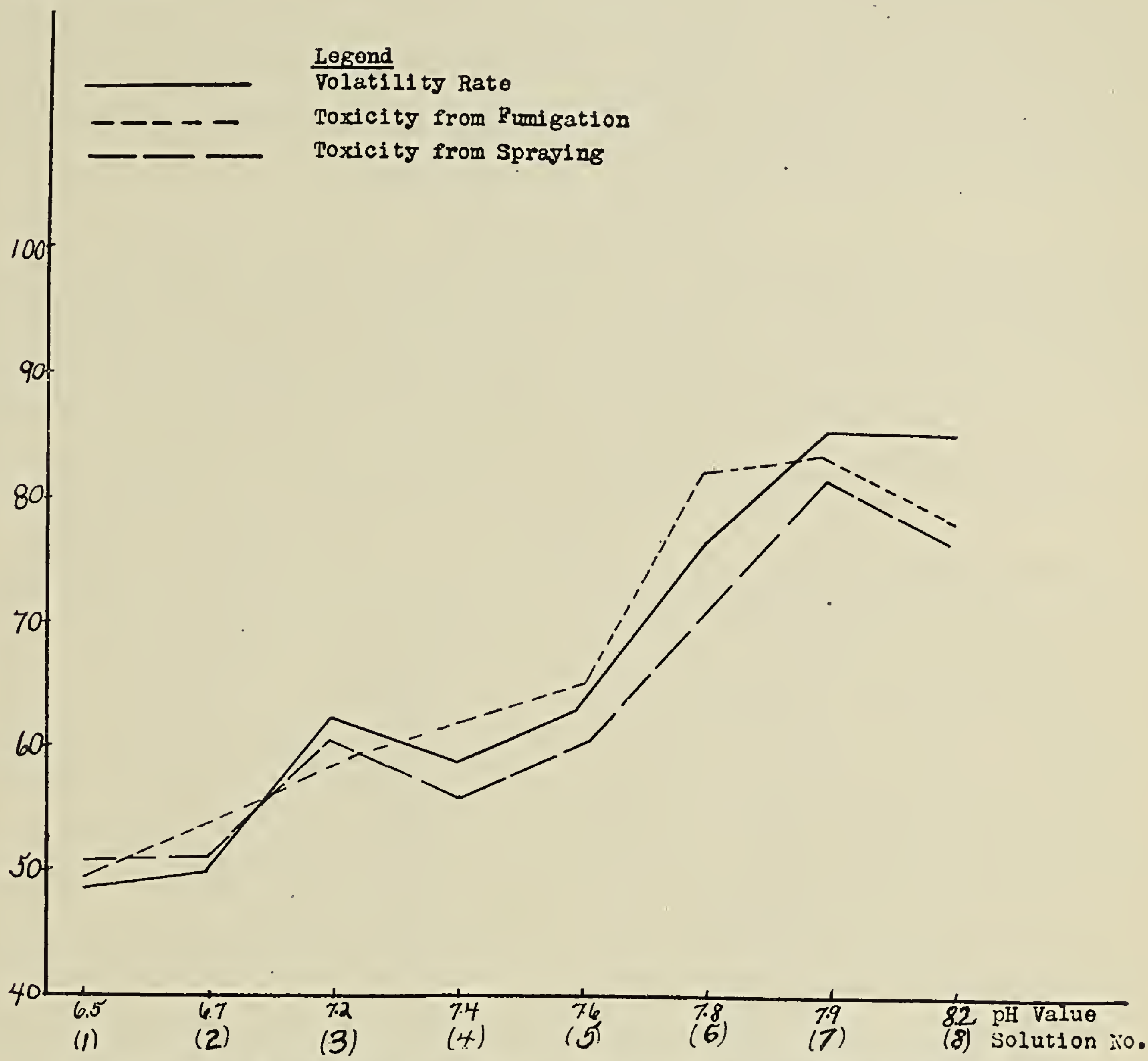

Fig. 5—Graph showing volatility rate and comparative toxicity from fumigation and spraying.

Practical Applications. To obtain the maximum efficiency of nicotine sulfate solutions, a slight excess of alkali should be added over the amount needed to combine with the sulfuric acid present. To one pound of nicotine sulfate add three ounces of hydrated lime or freshly slaked burned lime. Then for a two-hundred gallon tank of 1–800 solution of nicotine sulfate, 6¾ ounces of lime would be required, supposing the nicotine solution had a specific gravity of 1.2. If soap is used as the spreader, then add three ounces of sodium hydroxide (commercial lye may be substituted) or four ounces of sodium carbonate. One of the most convenient forms for the latter is commercial soda ash.

Waters that are very alkaline might, with the addition of soap or calcium caseinate, neutralize the combining acid present. However, such waters are not common and, in most instances, the total alkali

present is insufficient to free the alkaloid. Since we have no method of determining easily when the alkaloid is completely freed, the safest plan is to add a slight excess of alkali. If calcium caseinate is used as a spreader, it might be possible to reduce the amount of alkali added, but since many waters contain considerable quantities of carbonates or other lime-precipitating chemicals too much dependence should not be placed on the excess alkali in casein spreaders.

Nicotine Dusts

The use of dust carriers for nicotine instead of water, as developed by Professor R. E. Smith, has been a great advantage in certain types of work but with it have come some complicated problems. This is due to three reasons: first, the dilutant is at present sold with the nicotine

Table III. Volatility of Nicotine in Various Dust Carriers.[3]

No.	Form of Nicotine	Carrier		Time of Exposure	Pct. of Nicotine Recovered
		Substance	Proportion		
			per cent	Hours	
1	Free nicotine	Hydrated lime Sulfur	74.7 24.2	18	22.3
2	Free nicotine	Hydrated lime Sulfur	49.5 49.5	18	25.3
3	Free nicotine	Hydrated lime Sulfur	87.8 11.2	18	32.1
4	Free nicotine	Hydrated lime Sulfur	11.2 87.8	18	trace
5	Free nicotine	Sulfur	99.0	18	none
6	Free nicotine	Hydrated lime	99.0	18	45.7
7	Free nicotine	Sodium carbonate	99.0	18	none
8	Free nicotine	Kaolin	99.0	18	96.3
9	Free nicotine	Hydrated lime Water	94.95 4.05	18	54.6
10	Nicotine sulfate	Kaolin	97.5	18	100.0
11	Nicotine sulfate	Hydrated lime	97.5	18	25.1
12	Nicotine sulfate	Sodium carbonate	97.5	18	none
13	Nicotine sulfate	Ammonium carbonate	97.5	18	none
14	Nicotine sulfate	Hydrated lime Sodium carbonate	48.7 48.7	18	trace

[3]Temperature range 58° to 70° F.

and at a high price; second, the release of nicotine from dusts varies with the type used and to a certain extent with the amount of moisture present; third, the stability of the nicotine as found in nicotine sulfate solutions is lost when alkali is added to "activate" it. Free nicotine is so volatile and subject to chemical changes that it has thus far been impossible to store it for any length of time without loss. This emphasizes the value of the "self-mixing" duster which gives immediate use of the nicotine when first freed. Since volatility and toxicity are so closely related, it is apparent that a dust which releases nicotine very quickly is desired for high concentrations of volatile nicotine over short periods of time rather than a slow release over an extended period. To quote Professor Smith, "The greatest possibility of reducing the amount of nicotine used lies along the line of making it as quickly volatile as possible."

The data given in Table III show that the hydroxide compound releases the nicotine more slowly than the carbonates. Hydrated lime ($Ca(OH)_2$) gave a slower release of nicotine both in free and sulfate forms than did calcium or sodium carbonate (Na_2Co_3). This agrees with the analyses given by Thatcher and Streeter (N. Y. Exp. Sta. Bul. 501). Professor Smith states in California Experiment Station Bulletin 336, that "Lime carbonate makes a very satisfactory filler but has no effect upon nicotine sulfate . . . . . Hydrated lime reacts with nicotine sulfate, forming free nicotine." The carbonate of lime which Smith was using was principally waste forms of lime which may account for the difference in results. Limited spraying tests with these two bases confirm the chemical analysis, i. e., the carbonate carrier is superior to the hydrate.

A comparison of free nicotine and nicotine sulfate is also given and so far as the tests are completed, do not indicate a material difference between these two forms of nicotine. It will be noted that free nicotine is less volatile with hydrated lime as a carrier than is nicotine sulfate from carbonate carriers. It is doubtful whether the added danger to the operator and the possibility of loss by volatilization would warrant the substitution of free nicotine for the acid compounds in the making of dusts, at least in the present stage of experimentation.

Chairman R. E. CAMPBELL: The next paper on spraying equipment for citrus trees will be presented by Mr. Herbert.

SPRAYING EQUIPMENT FOR CITRUS TREES IN CALIFORNIA

By Frank B. Herbert, *Assistant Entomologist, Balfour Guthrie & Co.*

Abstract

There are two citrus districts in California,—Tulare County with medium sized open trees, where good results can be obtained with usual four horsepower spray machine,—and Southern California, with larger, denser trees, where the largest orchard sprayers (10 horsepower), are required. These machines have a capacity of 15 to 20 gallons per minute and carry 350 and more pounds pressure. Spray guns are used almost exclusively, with disc apertures ranging from $\frac{7}{64}$ to $\frac{9}{64}$ inches.

In Tulare County the average tree requires 8 to 10 gallons of solution, making a cost of 4 to 15 cents per tree for the application, and in Southern California, requiring 12 to 15 gallons, making the cost of applying run from 6 to 19 cents per tree.

From time to time growers and county officers have requested data on spraying equipment for citrus trees, with special reference to the pressure desirable, size of gun discs, number of gallons required per tree, cost of application, etc. Therefore the writer has endeavored to record some of the requirements in this paper, the data being taken from the records of sprayers and from general experience, and not from any special experiments performed.

Citrus Districts

There are two distinct citrus districts in California. Southern California, where spraying on a large scale for any pests except red spiders, is quite new, and Tulare County, where spraying has been the principal means of pest control for a number of years. Full grown citrus trees in the former district become very large and require special equipment in order to properly cover them, while those in Tulare County average much smaller and can be more easily covered with the ordinary sized spray machine.

Type of Machine

A great deal of the spraying in Tulare County is done by the individual grower who owns his own spray rig and does his work when he pleases. Most of these machines are of the larger sizes having single cylinder engines throwing from 8 to 12 gallons per minute. The "Bean" has been the favorite in this territory until now the "Friend" is coming to the front. As most of the trees are not over 15 feet high and are fairly open, the grower has been able to get by very well with this sized outfit. In quite a few cases the grower uses only one gun with this machine.

South of the Tehachapi, the commercial sprayer has been doing the bulk of the spraying, partly because it is a new business and partly because the trees have been so large that they required a large machine which the ordinary grower has not felt he could afford. Some of the smaller machines, which were used for spider spraying, are still in use,

but all the larger growers and commercial sprayers are demanding the largest orchard sprayers on the market, such as the Friend AXA, the Bean Super-Giant, and the Hardie Mogul. The Friend is the favorite here, having the largest capacity, besides being able to carry a pressure of 350 pounds or more with a minimum amount of upkeep. Each of these machines has a capacity of 15 to 20 gallons per minute and throws ample material to take care of two or more guns.

The sprayer when purchasing a new spraying outfit should not consider the initial cost alone, for with the cost of upkeep, the cheapest outfit is liable to more than balance the cost of the highest priced rig, without considering the aggravation and time lost from a poor machine. This applies particularly to the commercial sprayer, who must make every hour and dollar count for his season is short enough at best. The writer knows personally of a number of outfits requiring over $300.00 for upkeep per year, while more durable machines required only $10.00 to $35.00 for the same period.

Pressure

No one should attempt to operate a machine which will not carry at least 300 pounds pressure. This amount will suffice on small to medium sized open trees, but the best results on large trees have been obtained from machines carrying 350 to 400 pounds. A 130 acre grove of large trees in the Redlands section was classed as a 99.6 percent kill on Citricola scale last season. This had been sprayed with two medium sized rigs, but these results were obtained only by the most diligent work under and outside the tree, the sprayers even using ladders to reach the tops. The same results could have been obtained much more easily by using a rig with high capacity and pressure. Moreover this is the only grove of large trees where the writer knows of any such kill with a small rig. There have been a great many kills of better than 99 percent obtained much more easily where large outfits were used.

Spray Guns

The old time rod and nozzles have been replaced practically entirely by spray guns. If there is any occasion where the gun is more efficient than the rod, it is in spraying citrus trees. With the proper amount of pressure, the gun will break the material up and carry it to the tops of the tallest treess, and still do it more economically than any rod and nozzle. One hears occasionally from an "old timer" that he could do the same work and use less material with a rod. True, it could be done well with a rod, but only with the expenditure of a greater amount of energy and fully as much material. The only reason the rod might use

less material would be because the ordinary man hasn't the patience to stay at a large tree long enough with it to properly wet all the foliage. The gun will give a better washing and drenching effect on the tree than the rod.

The Friend and Hardie guns have proved to be the most popular makes. The Boyce double gun has been tried out to some extent, but has not proven to be any great success, except for medium sized open trees or for outside work, such as spraying for thrips. In inside work, which is essential in spraying for scale on citrus trees, the double gun gets caught to some extent on the foliage, and is tiresome to hold due to its heavy head. This same fault is found with the rod.

On the large machines the size of the aperature in the gun discs should be from $\frac{7}{64}$ to $\frac{9}{64}$ inches. If the machine is able to hold up its pressure with the larger discs, the more satisfactory will be the application for the greater the volume being forced through the gun, the farther the material can be thrown and this is essential on large trees. If at any time the material is being thrown too far, a simple turn of the handle widens the spray and shortens the distance it is thrown. With the smaller machines one should use one gun with a large disc or two with smaller discs, ranging from $\frac{4}{64}$ to $\frac{7}{64}$ inches. No gun should be used at less than 300 pounds pressure.

Hose

Some trouble has been experienced in getting hose to stand up under the high pressure used in Southern California. We find it must be at least seven ply and sometimes even this will give trouble in some brands. Half inch hose is used mostly, although a few of the large machines are equipped with $\frac{5}{8}$ inch material. The latter throws a nicer stream due to less friction, although it is considerably heavier to drag around. Two fifty-foot lengths are the usual equipment on each outfit.

Gallonage per Tree

In Tulare County the average amount of material required per tree is from 8 to 10 gallons. In some groves, 16 or 18 gallons are required to thoroughly drench the trees. In Southern California the trees average much larger, requiring 12 to 15 gallons, while some groves require as high as 25 gallons per tree. Individual trees have been seen that have had as high as 42 gallons applied before they were properly covered.

With small trees, two year olds require about one gallon each, 4 year olds, 2 gallons, 6 year olds, 4 to 5 gallons, with some of the thriftier taking as high as 10 gallons.

Cost of Application

Figuring in everything, it costs the grower who runs his own machine from $\frac{1}{2}$ to $\frac{7}{10}$ cents per gallon to apply the spray, while the commercial sprayer charges from 1 to $1\frac{1}{4}$ cents per gallon, most of them charging the latter.

Thus the cost of application on the average tree in Tulare county is 4 to 7 cents where the grower owns his own rig, or 8 to 15 cents when hired done by a commercial sprayer. In Southern California the average cost runs from 6 to 10 cents for the grower, and from 12 to 19 cents for the sprayer.

This was followed by a paper by Mr. R. E. Campbell.

NOTES ON NICOTINE DUST PROGRESS

By Roy E. Campbell, *U. S. Bureau of Entomology*

Abstract

This general historical account of the use of nicotine in dusts, is given with special reference to recent developments, the properties of carriers, the utilization of finely ground tobacco dust, the comparative merits of free nicotine and nicotine sulphate, the advisability of a certain amount of moisture, the mechanical devices for the application of dusts, data on self-mixing dusters and the possibilities of local mixing. An extended bibliography is given.

When ground tobacco dust, because of variation and slow release of its nicotine content, failed to satisfactorily control the walnut aphis, Professor Ralph E. Smith began the use of a dust containing a definite amount of standardized nicotine sulphate solution added to a dry carrier. Following that work, the use of nicotine dust was taken up by the Federal Bureau of Entomology, and soon afterward investigations were also started in California, New York, New Jersey, Virginia, Connecticut, Ohio, Missouri, Maryland, Wisconsin, and other States. It is doubtful if in recent years any insecticide has aroused so much interest on the part of the economic workers as nicotine dust.

Kaolin was first used as a carrier because of its availability, ease of grinding, and inertness. It was found, however, because of its compound nature, to adsorb and "tie up" too much of the nicotine, and lime, being less subject to this objection, was substituted. Refuse sugar-beet lime and hydrated lime, together with finely-ground sulphur, also have been used most extensively. More recently the carbonates of lime and magnesia have proved to have certain advantages, particularly in giving off the nicotine very readily. A combination of these occurs naturally in dolomite, which is coming into favor as a carrier.

It soon became evident, after conducting many experiments and ob-

serving the results of others, that the entomologist had gone about as far as possible with the problem of carriers for nicotine dust. It was necessary for the chemist to investigate the nature of the reactions between the nicotine solutions and the different carriers. Experimental evidence indicated that nicotine dust was more effective when made up with certain carriers than with others, but the exact reasons were not well understood. As a result of the excellent work recently done by the economic workers of New York and New Jersey, we now know which carriers are active; i. e. (1) those which actually cause the nicotine to be released quickly; (2) those which are inactive and have no effect on the nicotine, except to expose it for evaporation, and (3) those which adsorb the nicotine and retard its release. It was also demonstrated that there is a difference in the reaction of nicotine sulphate and free nicotine to some of the carriers, and that the moisture content of the carriers affects dust made from the two types of nicotine differently. The entomologist can now proceed to find out whether a very quick release of the nicotine or a more gradual release gives the best killing, and whether free nicotine or nicotine sulphate makes the most effective dust. Probably these will differ in killing power when applied to different forms of insects under varying conditions.

The problem is further complicated from the manufacturer's viewpoint, who does not wish to make a dust which may lose its nicotine if held in storage for several months, nor a dust which retains the nicotine after the material has been applied. The ideal carrier would be one which retains the nicotine indefinitely in storage, but releases it readily when the dust is applied to plants. Perhaps the chemist may find some material, or combinations of material, suitable for such a carrier.

Nicotine dust was first manufactured by a cooperative walnut growers' association in 1918 at Santa Barbara, Cal. It proves so successful that a subsidiary company of the California Walnut Growers' Association was formed to make dust not only for its own growers, but for growers of fruit and vegetables as well. Since then the production has increased until there are at least five manufacturers of nicotine dust in the western, and six in the eastern United States. The total production of nicotine dust is shown as follows:

Table I. Total Production of Nicotine Dust in the United States

Year	1919	1920	1921	1922	1923
Number of factories	1	2	3	8	11
Tons produced	400	225	425	970	1925*

*Production from one factory estimated for 1921, 1922 and 1923.

An interesting fact has occurred as a result of the rapid increase of nicotine dusting. It might be supposed, because of the large amount of nicotine used in the dust form, that liquid spraying with this material had decreased. On the contrary, the use of nicotine in dust form seems actually to have stimulated its use as a liquid spray, for more is being sold for this purpose than ever before.

Another development is a stimulation of the use of ground tobacco dust. Some manufacturers have advertised this material, but because of the variable amount of nicotine in ground tobacco and also because it does not volatilize so readily, its use has not been entirely successful. Recent experiments performed in New York with a finely-ground tobacco indicate that while on the basis of its nicotine content, ground tobacco is more expensive and slightly less active than nicotine dust, yet it gives sufficiently satisfactory results to be worthy of further investigation.

For several years the source of nicotine for all dusts was a solution of nicotine sulphate containing 40 per cent of nicotine. With this it was customary to use some hydrated lime, or other "active" material, which caused a reaction and liberated the nicotine. Recently some manufacturers are utilizing a solution of free nicotine which eliminates the need of using an "activator." There is a tendency also toward the use of a solution containing a higher percentage of nicotine. Some manufacturers claim better results with the free nicotine than with the sulphate, while others who continue the use of the sulphate, maintain that it is the most satisfactory. The free nicotine solution is a little more expensive, and the increase in the concentration of nicotine also increases its cost per unit. Recent experiments in New Jersey have demonstrated that a dust made of dolomite and free nicotine gave a better killing than one composed of hydrated lime and nicotine sulphate. The superiority of the free nicotine dust was due to a greater evolution of gas in a given period of time. It has also been demonstrated that nicotine sulphate in a dolomite carrier releases its nicotine more rapidly than in hydrated lime, so that the comparison of the two types of nicotine in two different carriers is not conclusive.

A certain amount of moisture is desirable in nicotine dust when compounded with nicotine sulphate, as the reaction is thereby hastened, but too much moisture is disadvantageous, because some of the nicotine may be dissolved. It is difficult also to thoroughly incorporate such a quantity of liquid into the carrier, without resulting in a dust which is too moist for satisfactory application. The presence of moisture is

especially undesirable in dust made with free nicotine, as the moisture has a tendency to absorb the nicotine. An excess of moisture may be partially overcome, in some cases, by the use of a drier, such as quick-lime or plaster of Paris, but here complications may arise because of the action of these driers on the nicotine. The use of a solution containing a higher concentration of nicotine would, of course, remove both of the above objections in making high-strength dusts, but it in turn is objectionable because of the higher cost of the nicotine.

When the practice of applying nicotine dust as an insecticide was first begun, the only machines available were those which had been developed for dusting with arsenate of lead and sulphur. These machines were utilized for nicotine dusting, and were gradually improved to give a better feed of dust and a larger volume of air, since usually it was desirable to apply a greater amount of nicotine dust than of materials previously used, and in most cases to run the dust through the fan itself, thus breaking up any lumps which might have remained in the mixture. In addition, booms were perfected to apply the dust to rows or field crops as the machine was driven over them.

In order to hold the dust as long as possible around low-growing plants and at the same time to overcome the effects of wind blowing away the dust or fumes, several devices were made. One was a box-like enclosure, entirely surrounding the machine, into which the dust was discharged through individual pipes leading to the rows. Another device consisted in merely attaching a piece of canvas, a little wider than the strip of rows to be covered, to the back of the duster, and allow the canvas to trail behind. The canvas not only holds down the dust about the plants, but in dragging it over them, it knocks off many insects such as aphids. The increased activity of the aphids, in crawling about on the ground or the plants, renders them more susceptible to the action of nicotine. Some have used trailers 15 to 20 feet long, but the writer has obtained best results on peas infested by the pea aphis with one 40 feet long. The only limit to the length of the canvas trailer is the ease of handling it in turning at the ends of the rows. The canvas must not be long enough or heavy enough to injure the plants. It has been found advisable also to hang a weighted piece of canvas just ahead of the nozzles. This reaches below the tops of the plants and prevents the dust from escaping in front.

Other devices have been used, such as U-shaped inverted troughs, 4 feet long, attached to the rear of the dusting machine. A trough covers each row to be treated, and the dust is discharged into it. As

the machine proceeds down the rows, the troughs prevent the escape of most of the dust. These troughs are especially useful in windy weather.

Early in his work with nicotine dust, Professor Smith conceived the idea of a self-mixing duster, in which the nicotine solution and carrier could be mixed at the time of application. During the 1922 season such a machine was developed, being an adaptation of one of the regular dusters on the market. Early in 1923 two different firms began the manufacture of self-mixing dusters. Both of these have been tested, and while subject to some mechanical imperfections, as might be expected in new machines, the success of self-mixing dusters was demonstrated. The advantages of self-mixed dust are as follows: (1) The dust is much cheaper, being limited to the cost of raw products only; (2) it is perfectly fresh; (3) it is hot from the mixing and chemical reactions, and therefore more active; (4) there is no loss of nicotine from storage, and (5) it is possible to make quickly any strength desired. Of course, there still will be a large demand for the ready-made dusts, for use in the machines not suited for self-mixing, and in hand dusters. Many growers do not care to take the time and trouble of mixing their own materials, while others feel that with the type of labor available in some localities, the possibility of using the wrong dosage and improper mixing will be too great. The self-mixing dusters can be used for applying ready-made dusts, arsenate of lead, sulphur, or other necessary material.

Considerable emphasis has been placed on the thoroughness of mixing nicotine dust, and many have doubted if the self-mixing machines would do this satisfactorily. Professor Smith recently tested this by placing 40 pounds of hydrated lime and 2 pounds of 40 per cent nicotine sulphate solution in the hopper and running the machine for two minutes. A sample was then taken from near the top and one from near the bottom of the hopper. The machine was then run 8 minutes and two more samples taken. These were analyzed by the California State Department of Agriculture and showed the following percentages of nicotine: 1.88, 1.89, 1.88 and 1.87, thus definitely proving the evenness and thoroughness of the self-mixing operation.[1]

A later analysis gave the following results:

[1]Data from personal correspondence.

Table II. Analyses of Nicotine Dust from Self-Mixing Duster. Dust Made With 2 Pounds of 40 Per Cent Nicotine Sulphate and 50 Pounds Lime

Sample	Time of mixing	Remarks	Sample taken from	Nicotine content
1	1 minute	Lumps discarded		1.41 per ct.
A	2 minutes		Side	1.23 "
B	2 "		Center	1.49 "
C	2 "		Deep center	1.44 "
D	2 "		Side	1.38 "
E	2 "		Center	1.59 "
X	2 "	Ran 1 min. lumpy Then ran 2 mins.		1.59 "
B3	3 "			1.56 "
B31	3 "			1.56 "
B3c	3 "		Deep center	1.43 "
B3s	3 "		Side	1.41 "
B3T	3 "		Top	1.54 "

A recent development in the distribution of this compound has been local manufacture of nicotine dust. This involves both mixing and distribution by local dealers or growers and makes available high grade dust in small quantities.

Nicotine dust prepared by a large manufacturer and shipped long distances is necessarily somewhat high-priced. To the cost of making and the manufacturer's profit, must be added necessary profits for the distributor and retailer, which, with rather high freight rates, may make the price per pound almost double the actual cost of the raw materials.

Mixing machinery is neither very expensive nor complicated. As a consequence, local dealers in communities where there is considerable demand for nicotine dust, especially where they are located at some distance from a manufacturer, are installing their own machinery, and buying the raw products, mixing and selling the dust directly to the growers. When this is done the distributor's profit, and often the retailer's profit can be deducted, as well as the freight charges, which permits the sale of the dust at a very low rate.

The large manufacturer can, of course, compete with such local manufacturers by installing mixing machinery at his branch houses, and by dealing directly with retailers or growers, thus eliminating freight rates for long hauls on the manufactured dust, and also the distributor's or jobber's profit. It is probable that ultimately most of the nicotine dust will be made either in the self-mixing machines, or by a number of comparatively small local manufacturers, distributed over

the country, and that such manufactured dust will be used within a territory a few hundred miles from the factory.

Such manufacturers will have the advantage of being able to sell cheaply to local trade and to make up an order and quickly send out freshly-made dust, thus largely eliminating the possible deterioration while in storage, and furthermore will be able to specialize on the type of dust best suited to their particular localities.

BIBLIOGRAPHY

1. McIndoo, N. E. Effects of nicotine as an insecticide. U. S. D. A. Jr. Agr. Research, v. 7, pp. 89–121, 1916.
2. Essig, E. O. The pear thrips. Calif. Univ. Agr. Exp. Sta. Circ. 223, pp. 9. 3 figs., Nov. 1920, Nicodust kills all exposed thrips.
3. Capmbell, R. E. Circ. 154, U. S. D. A., Feb. 1921, Nicotine sulphate in a dust carrier against truck-crop insects. 15 p.
4. Parrott, P. J. Jr. Econ. Ent., Vol. 14, No. 2, April 1921, pp. 206–214. Control of sucking insects with dust mixtures.
5. Headlee, T. J. Jr. Econ. Ent., Vol. 14, No. 2, April, 1921, pp. 214–220. Dusting as a means of controlling injurious insects.
6. Giddings, N. J., Jr. Econ. Ent., Vol. 14, No. 2, April, 1921. pp. 225–232. Orchard dusting vs. spraying. Discussion, pp. 232-238.
7. Howard, W. L. Nicotine sulphate dust destroys certain crop pests in California. In Jour. Agr. California, v. 7. p, 30, May, 1921.
8. Howard, W. L. Use of dust sprays in California. Illus. In Better Fruit, v. 15, p. 3, June, 1921.
9. Zimmerly, H. H., Geise, F. W., and Willey, C. R. Virginia Truck Exp. Sta. Buls. 35 and 36, April–July, 1921. Dusting vegetable crops. pp. 193–208.
10. Horne, W. T., and Essig, E. O., Plant Disease and Pest Control. Calif. Sta. Ent. Cir. 227, Univ. of Calif., June, 1921, 69 p. Page 64–65. Nicodust and Combinations.
11. Essig, E. O., Jr. Econ. Ent., vol. 14, No. 5, Oct. 1921, p. 392–394. Dust Insecticides in California.
12. Morrill, A. W., Jr. Econ. Ent., Vol. 14, No. 5, Oct. 1921, p. 394–400. Notes on the use of insecticide dusts.
13. Severin, H. H. P., Hartung, W. J., Schwing, E. A., and Thomas, W. W., Jr. Econ. Ent., Vol. 14, No. 5, Oct. 1921, p. 405–410. Experiments with a dusting machine to control the beet leafhopper, *Eutettix tenella* Baker, with nicotine dust.
14. Smith, R. E., Calif. Agr. Exp. Bul. 336, p. 261–274, Nov. 1921. The preparation of nicotine dust as an insecticide.
15. Parrott, P. J., Glasgow, Hugh, and MacLeod, G. F., N. Y. Geneva Exp. Sta. Bul. 490, Nov. 1921. Control of apple red bugs by dusting. 30 p., 4 pl.
16. Moznette, G. F., Jr. Econ. Ent., Vol. 14, No. 6, Dec. 1921. p. 465–469. Dusting vs. spraying for the control of insect pests of the avocado.

17. HEADLEE, THOS. J., In 42d Ann. Rept. of N. J. State Agr. Exp. Sta. for 1921. Effect of nicotine-impregnated dust on leafhopper on the apple. Effect of different sprays and dust on apple aphis—species *Aphis avenae.* p. 374–375, pub. 1922.

18. HOWARD, W. L. Nicotine dust and *Typhlocyba comes.* In California Cultivator, v. 56, p. 671, 1921.

19. MCINDOO, N. E. Effects of nicotine sulphate as an ovicide and larvicide on the codling moth and three other insects. By N. E. McIndoo, F. L. Simanton, H. K. Plank and R. J. Fiske. 1921. U. S. D. A. Bul. 938.

20. HEADLEE, T. J., and RUDOLFS, WILLEM, Jr. Econ. Ent., vol. 15, No. 1, Feb. 1922, p. 75–81. Some further experience with contact dusts.

21. PARROTT, P. J., Jr. Econ. Ent., Vol. 15, No. 1, Feb. 1922, p. 82–85. Control of sucking insects by dusting.

22. DELONG, D. M., Jr. Econ. Ent., vol. 15, No. 1, Feb. 1922, p. 87–90, pl. 2. The boom nozzle system and the traction duster as factors in grape leafhopper control.

23. BRITTON, W. E., ZAPPE, M. P., and STODDARD, E. M., Conn. Exp. Sta., New Haven, Bul. 235, Feb. 1922. Experiments in dusting vs. spraying on apples and peaches in Connecticut in 1921. p. 207–226. Ills. pl. xvii–xxii.

24. CARDINELL, H. A., and PAGE, E. M., Univ. of Missouri Ex. Circ. 110, Mar. 1922. Melon pest control in southeast Missouri. 20 p. Nicotine sulphate dust p. 4–5.

25. RUSSELL, H. L., and MORRISON, F. B., Ann. Rept. Agr. Exp. Sta. Univ. of Wisconsin, 1920–1921. Nicotine dust employed against insects. p. 59–61 (Wis. Agr. Exp. Sta. Bul. 339, Feb. 1922, 193 p.)

25–A. CARDINELL, H. A., and PAGE, E. M., Truck crop pests controlled by new methods. Market Growers' Journal, Vol. 30, No. 9, May 1, 1922.

26. WHITE, W. H., Circ. 224, U. S. D. A., June, 1922, Nicotine dust for control of the striped cucumber beetle (*Diabrotica vittata* Fab.) 8 p. ills.

27. ESSIG, E. O. (Notes on control of caterpillars with nicodust.) In Jr. Econ. Ent., vol. 15, No. 3, June, 1922, p. 247.

28. CAMPBELL, R. E., Farmers' Bulletin 1282, U. S. D. A., Sept. 1922, Nicotine dust for control of truck crop insects. 24 p. illus.

29. GEISE, F. W., ZIMMERLEY, H. H., and SPENCER, HERBERT, Virginia Truck Exp. Sta. Bul. 41, Oct. 1922, Spraying and dusting vegetable crops in 1922, p. 237–256. Figs. 47–57.

30. FLEBUT, A. J., Use of nicotine dust in the control of citrus thrips. Calif. Dept. Agr. Monthly Bul. v. 11, No. 10, p. 745–754. Oct. 1922.

31. RUDOLFS, WILLEM, In Jr. Econ. Ent., Vol. 15, No. 6, Dec. 1922, p. 421-424. Nicotine delivery from dust carriers.

32. PARROTT, P. J., STEWART, F. C., and GLASGOW, HUGH, N. Y. Geneva Agr. Exp. Sta. Cir. 63, Dec. 1922. Spraying and dusting experiments with apples in 1922. 8 p.

33. HARTZELL, F. Z., N. Y. Geneva Agr. Exp. Sta. Circ. 65, Dec. 1922. Spraying and dusting experiments for pear Psylla in 1922. 8p.

34. CORY, E. N., In Jr. of Econ. Ent., Vol. 16, No. 1, Feb. 1923, p. 81–84. Dusting for the pea aphis.

35. RUSSELL, H. L., and MORRISON, F. B. Wis. Exp. Sta. Bul. 352 (Ann. Rept. 1921–1922, Feb. 1923). Effect of nicotine dusts on crop insects. pp. 68–73.
36. PARROTT, P. J., and GLASGOW, HUGH, Jr. Econ. Ent., Vol. 16, No. 1, Feb. 1923, p. 90–95. The insecticidal properties of tobacco dust.
37. PETERSON, ALVAH, N. J. Agr. Exp. Sta. Bul. 378, Feb. 1923, The Blackberry Psyllid, *Tricza tripunctata* Fitch. 32 p. incl. 5 pl. Dusting, p. 29–30.
38. THATCHER, R. W., and STREETER, L. R. Factors which affect the volatility of nicotine from insecticide dusts. N. Y. Geneva Agr. Exp. Sta. Bul. 501. Mar. 1923, 34 p. Literature cited: p. 34.
39. SMITH, R. E., and MARTIN, J. P., Calif. Agr. Exp. Sta., Bul. 357, April, 1923. A self-mixing dusting machine for applying dry insecticides and fungicides. p. 497-506 and figs.
40. MACLEOD, G. F., and HARMAN, S. W. The aphiscidal properties of tobacco dusts. N. Y. Geneva Agr. Exp. Sta. Bul. 502, Apr. 1923. 18 p. 3 pl.
41. CARDINELL, H. A., and LEWIS, E. P., Killing cuke beetles and melon aphis in 1923. Market Growers' Journal v. 32, p. 265, Apr. 15, 1923.
42. ROSS, W. A., and ROBINSON, W. Susceptibility of grape leafhopper eggs to nicotine. Agr. Gaz. Canada, V. 10, p. 230–231, May 1923.
43. ZAPPE, M. P., and STODDARD, E. M. Conn. New Haven Bul. 245, Dec. 1923. Results of dusting vs. spraying in Connecticut apple and peach orchards in 1922. p. 229–243.
44. DUDLEY, J. E., WILSON, H. F., and MECUM, W. D. Nicotine dust kills cucumber beetles. Wis. Agr. Exp. Sta. Bul. 355, June, 1923. 10 p.
45. DUDLEY, J. E., and others. Nicotine dust kills cucumber beetles. Wis. Agr. Exp. Sta. Stencil Bul. 72, 1923, 2 p.
46. GRAY, G. P., COLBY, G. E., and others. Economic poisons. Calif. Dep. Agric. Special Pub. No. 34, 1923, 62 p. Nicotine dusts. p. 42–43.
47. SANDERS, G. E. Nicotine dusting. Quebec Soc. for Protection of Plants. Report 15, p. 37–39, 1923.
48. HEADLEE, T. J., and RUDOLFS, W. Some principles which underlie the making and use of nicotine dusts. N. J. Agr. Exp. Sta. Bul. 381. 1923.
49. PARROTT, P. J., and MACLEOD, G. F. Tobacco dust as a Contact Insecticide. Jour. Econ. Ent., Vol. 16, No. 5, October, 1923, pp. 424–430.
50. WALDEN, B. H., Nicotine Dust as a Control of the Turnip Aphid. In 22d Ann. Rept. Conn. Sta. Ent. for 1922, Conn. Agr. Exp. Sta. Bull. 247, pp. 346-7.

A discussion on dusts was led by Mr. Campbell. Among other things there arose the question as to when an entomologist should recommend control measures. Some differences of opinion developed, but it was generally felt that insects with only one or possibly two generations a year must be considered differently than those with many generations and which develop serious infestations in a few weeks. It was finally agreed that the best rule to follow was to consider the infested crop or orchard as if owned by the entomologist and make control recommendations accordingly.

Meeting adjourned.

Afternoon Session, September 18, 1923

The excursion, previously announced, was attended by 30 members and visitors, who were shown the process of manufacturing nicodust and dusting machines, liquid hydrocyanic acid gas and calcium cyanide, and the methods of propagating and rearing parasites and predaceous insects for biological control.

Morning Session, September 19, 1923

The meeting was called to order by chairman R. E. Campbell who announced the order of business as a symposium on biological control under the leadership of H. S. Smith, in charge of Beneficial Insect Investigations, Univ. of Calif.

The following papers were presented:

WHAT MAY WE EXPECT FROM BIOLOGICAL CONTROL?

By Harry S. Smith, *University of California, Citrus Experiment Station*

Abstract

Biological control work has been subject to extremes of popular approval and disapproval. This is due to a lack of understanding, on the part of the general public, of just what results may reasonably be expected from this method. Success is dependent upon biological principles with which the grower is not always familiar. Some insect pests are favorable subjects for attack by this method and others are not. It is pointed out that the proper co-relation between host and parasite and freedom from secondary parasites, are important factors in this type of control. The future is bright for this branch of economic entomology.

The control of citrus pests by the use of their natural enemies is a phase of scientific agriculture which has appealed to California growers for many years. At no time since the introduction of the Australian ladybird, Vedalia, in the early 80's, which resulted in the saving of the citrus industry from the ravages of the cottony cushion scale, has the California fruit grower lost interest in this method of pest control. His interest in the subject has not, however, been at a uniformly high pitch during this entire period. The introduction of Vedalia was naturally followed by a wave of enthusiasm for the introduction of parasites, not alone among growers but among some entomologists as well, which, as we have since learned, was hardly justified but which is easily understood in view of the striking results of this introduction. During this period the feeling was quite general in California that any pest could be controlled simply by the introduction of *its parasite*.

For several years after the introduction of Vedalia enthusiasm was high; but failure to secure similar results with other insect pests had its effect and interest began to slacken somewhat. Then Scutellista, a parasite of the black scale, was introduced from South Africa in 1902.

This parasite thrived wonderfully under California conditions and gave promise for a time of doing to the black scale what the Vedalia did to the cottony cushion scale. As time passed, however, and the black scale failed to disappear from the orchards in spite of comparatively heavy parasitism, this second wave of enthusiasm for the biological method of pest control began to lose its force. From then until 1918 was a period during which there was no more than a very general interest in this method. In 1918 the work of the California State Department of Agriculture on the biological control of the citrus mealybug began to make itself felt and interest in this subject began to reawaken. It was not, however, until the successful introduction and establishment by the Department of *Aphycus lounsburyi* Howard as an aid in the control of black scale, that interest in biological control again reached its height. History repeated itself, and there was a tendency again to expect greater results than the facts in the case warranted. However, this wave of what might be termed "over-enthusiasm" has receded, and there is now, I believe, a pretty general understanding on the part of the growers of just what may reasonably be expected in the way of control of the black scale by Aphycus.

My purpose in calling attention to the effect on the interest of the fruit grower of these various efforts to control pests by the biological method is to bring about a better understanding as to just what part natural enemies should play in our general scheme of pest control. Over-enthusiasm generally has a reaction which is not beneficial. The greatest good will come from biological control only when the majority of our agriculturists have a better understanding of the principles involved and the limitations to which the work is subject.

In appraising the possible value of the biological method as a pest control measure, there are certain more or less fundamental biological principles which must be taken into consideration.

In the first place, just what is meant by "biological control?" It means the suppression of insect pests by the use or encouragement of those organisms which in nature tend to reduce their numbers. All forms of life are subject to the action of factors which limit their increase. The most important of these are meteorological conditions, which include heat, rain, cold and drought; limited food supply; fungous and bacterial diseases, which destroy numbers of insects, especially in the more humid climates; and predatory and parasitic enemies. These various limiting factors taken together form what is known as "natural control."

On account of the fact that in California fungous and bacterial diseases of insects do not generally thrive, biological control in this state resolves itself into a matter of making use of beneficial insects alone.

While all insects have natural control factors working against them, they do not all have natural enemies among the parasitic and predatory insects, at least not effective ones.

Some insects are serious pests not because they have been introduced from a foreign country without their natural enemies, but because man has altered their environment in such a way as to provide a more satisfactory habitat and food. The Colorado potato beetle is a good example of this type. It is a native of the plains region at the base of the Rocky Mountains and its native food plant is the sand-bur, *Solanum rostratum*, a plant related to the potato. Upon the introduction of the potato, this beetle transferred its attention to that plant, and finding it much more to its liking, was able to multiply more rapidly and thus developed into a serious pest. A somewhat similar case is that of the grape Phylloxera, which is also a native insect and which became an important pest because of the introduction into the United States of the *vinifera* varieties of grapes from Europe, a type of grape which was a more favorable food plant than the native American grapes and which had developed no immunity to the pest.

Neither of these insects has natural enemies of importance and therefore the biological method is not applicable so far as at present understood. I cite these two cases merely to emphasize the fact that there are certain pests against which there is apparently no possibility of using this method in a practical way.

A general study of the problem indicates that the relative importance of insect enemies in the natural control of pests varies all the way from practically nothing, as in the cases above cited, to the most important of all factors making up natural control, as exemplified in the case of the Vedalia and the cottony cushion or fluted scale. Since, in California at least, the application of the biological method is practically confined to the use of insect enemies, the applicability of this method to the control of pests is dependent upon the availability of effective parasitic and predacious insects. It should be plain therefore that the degree of control which may be effected, may vary all the way from nothing to practically complete control, depending upon (1) whether or not effective natural enemies exist, and (2) whether introduced natural enemies find climatic and other environmental conditions satisfactory for their multiplication in their new habitat. This is, of course, a

statement of perfectly obvious facts, but there are many complications which enter into the situation and determine the *degree* of control which may be brought about.

Assuming that natural enemies of apparent value are located and successfully shipped to destination, that their life-history and habits are definitely determined and that a sufficient breeding stock is on hand, upon what conditions does practical success depend? Among known factors which bear on this question the following are important:

There must be the proper co-relation between the life-history of the parasite and that of the pest. No better demonstration of this principle could be asked than that exhibited by the black scale and the Aphycus. Aphycus thrives in the coastal areas of the state, where the life-history of the black scale is such that the stages of development upon which Aphycus is able to breed exist at all times of the year. On the other hand, it does not thrive in the interior, where for several months at a time these stages are not present and the parasite is therefore unable to maintain itself in abundance for lack of the proper hosts. This principle is fundamental. It is conceivable however that we may find parasites whose life-histories more nearly correspond to that of the black scale under interior conditions. The same is probably true of the citricola scale, which has only one generation a year. On the other hand the red and purple scales have several generations per year and from this standpoint are more favorable subjects for biological control. Because most scale parasites are short-lived and must pass through several generations a year to maintain themselves in abundance, it follows that scale insects such as the red and purple scales, the black scale under coastal conditions and the mealybugs are more favorable subjects for biological control than are such pests as the citricola scale or the black scale under interior conditions. There are however two possibilities by which these latter pests might be brought under control by the biological method. We may succeed in finding parasites which have life-histories corresponding to that of these scales or predators which feed on all stages, or we may develop methods of propagation of the natural enemies in such a way that we can afford to stock the orchards artificially every year with the parasites. The latter procedure may seem far-fetched, but the possibilities of this kind have not been exhausted. The control of these pests costs the citrus growers as much as $50 per acre per year. A very considerable sum could be expended in the production of natural enemies for orchard use, and still leave a margin of profit over fumigation costs, provided, of course, it could be done with equal effectiveness.

The writer is quite free to admit this has not yet been demonstrated except in the case of the mealybug.

The beneficial species which are to be employed must be comparatively free from the retarding effects of secondary parasites existing in the local fauna, which sometimes strongly attack the primary parasites used. Undoubtedly in some cases this factor will be sufficient to render the work unsuccessful, because when by artificial manipulation a superabundance of natural enemies of the pest is created, we thereby form an environment which is favorable for the secondary parasites. In other cases this will merely serve to reduce the degree of control. In most instances it will be practically impossible to foretell just what would happen in this direction and a practical attempt must be made in order to ascertain just what part the secondary parasites would play, and also the primary parasites of predacious insects. Undoubtedly this factor will limit or entirely prevent the control of some of our insect pests by this method. The attack of secondaries which occurred in the local fauna before the introduction of *Aphycus lounsburyi* has already greatly reduced the effectiveness of that valuable parasite, and this was also true in the case of certain parasites introduced into New England by the United States Department of Agriculture for control of the Gipsy moth. We can and do by careful work exclude new secondaries, but there are native secondaries which frequently attack the newly introduced beneficial insects. This of course cannot be prevented.

It seems hardly necessary to state that these two principles, i. e., the adaptability of the beneficial insects to their hosts and their relation to secondary parasites, are the ones on which in a large measure success will depend, and the degree of success attained will vary in accordance with the fulfillment of these requirements. The important thing to be impressed upon the general public, and the thing which has not been generally understood in the past, is that so far as our present knowledge goes not all pests are susceptible to control by the biological method, but that *most of them can be influenced to some extent* by the use of natural enemies, the degree of control being dependent largely upon ecological factors. When this is thoroughly understood there will be less false hope aroused and fewer disappointments and, in the opinion of the writer, the work will be strengthened thereby.

In the actual work of locating new parasites in foreign countries and in collecting, shipping and rearing this foreign parasitic material, many very difficult problems are met. Transportation of material, especially when collected in such far-away places as India, China or South Africa,

is very troublesome even when cold storage is used, and in many instances it has been necessary to persist for several years before a successful shipment is made. The successful shipment of material to this country is only part of the battle. Careful life-history studies of the parasite must be made to determine beyond any doubt that it is a primary in its habits, that is, that it will not attack any of our beneficial species, as the Quaylea does the Aphycus at the present time. With only a very limited supply of breeding stock available and with a parasite of more or less unknown habits, this is difficult and frequently results in the loss of the colony. Often the two sexes do not appear at the same time, with the result that the shipment is finally lost through lack of fertilization of the eggs. Most of these difficulties can however be overcome by sustained effort and are not a permanent barrier to success.

The writer confessses to a feeling of optimism for the future of biological control work. The field has scarcely been scratched. There are thousands of species of beneficial insects throughout the world. There are great improvements to be made in the propagation and manipulation of species already available. The work has its limitations just as does the control of human disease by the use of serums, vaccines and antitoxins, but even partial success will return a large profit on the sum invested in such projects.

THE PRESENT STATUS OF *APHYCUS LOUNSBURYI* HOW. IN SOUTHERN CALIFORNIA

By H. M. Armitage, *University of California, Citrus Experiment Station*

Abstract

In the "uneven hatch" areas secondary parasitism has precluded *Aphycus lounsburyi* How. becoming, by itself, an adequate means of control of black scale, except, possibly, at irregular intervals. Eight hyperparasites are known to attack Aphycus and three others are under suspicion. It is, however, of much value in the uneven-hatch areas as an aid to fumigation by evening up the hatch.

In the interior or "even-hatch" areas, low temperatures which cause retarded development of Aphycus, particularly in the pupal stage, during the one short period when it might alone control the scale, prevents its doing so. Aphycus, with *Scutellista cyanea* and *Rhizobius ventralis*, completes a sequence of enemies attacking the black scale and this fact offers a possiblility of control.

The distribution of *Aphycus lounsburyi* has been so complete, both with and without human agency that it is safe to say there is hardly a citrus orchard, or for that matter a planting of ornamentals or growth of native shrubbery in Southern California, infested with black scale, in which it is not possible to find Aphycus or evidence of its work. In spite of the many factors operating to its disadvantage it is without question a most valuable addition to the parasite fauna of California.

Four years observation on the work of *Aphycus lounsburyi* How. as a parasite of the black scale, following its introduction and successful establishment in the citrus orchards of Southern California by the

State Department of Agriculture in the fall of 1919, have definitely established its limitations as a factor in the control of that pest. They have also corroborated, to a large extent, the results of the work carried on in the early experimental plots and have brought to light a factor, secondary parasitism, which it was hoped might be avoided.

As has been fully explained in the earlier reports of the introduction and establishment of this parasite, two distinct field conditions termed "uneven hatch" and "even hatch," required consideration in determining to just what extent it might become a factor of control. These two field conditions, the first of which embraces the coastal areas in which the scale has one or more overlapping generations, and the second, the interior areas with a single uniform generation must still be considered separately in recording the present status of this parasite.

Coastal or "Uneven-hatch" Conditions

At the time of its introduction it was obvious that the mild climate of the coastal areas together with the overlapping generations of the black scale, offered an ideal condition for the Aphycus to gain the ascendency through rapidly succeeding generations, if it was at all adapted to California's climatic conditions. Little surprise was occasioned, therefore, among those carrying on the work at the rapidity of its spread and the apparent thoroughness of its work in these areas when once established. Appreciating, however, from previous experience with such problems, that newly introduced insects often have an immediate "flare-up" which they are unable to maintain through succeeding seasons, every effort was made not to create any undue enthusiasm among the growers, and in fact this policy was so closely adhered to that it reacted to the extent of the growers taking matters into their own hands. The efficiency of the Aphycus was so obvious to them that they hailed it as a second Vedalia. Wide-spread distribution of field-collected parasites was made through their own organizations. Large tracts of orchard were allowed to go untreated otherwise, in many cases successfully the first two seasons; later, however, there was a heavy loss from the smutting of the fruit and foliage from a heavy infestation of scale; sale of fumigation tents was even considered but fortunately never carried out.

Burdened with an annual fumigation bill running well into seven figures, the growers are perhaps not to be blamed for grasping at such a promising "straw" in their efforts to reduce costs. It is with regret that I find it necessary to record that a factor, secondary parasitism, not entirely unexpected but one which it was hoped might be avoided, has entered into the question and has reduced the efficiency of the Aphycus

in the "uneven-hatch" areas to a point where it cannot alone control the black scale. It is, however, logical to assume that this secondary parasitism will result in the usual cycle, with recurring periods of efficiency on the part of the Aphycus followed by periods of ascendency on the part of the secondaries.

Up to the present time eleven hyperparasites have been taken associated with Aphycus. Eight of these have been demonstrated experimentally in the laboratory to attack the Aphycus, the other three being under suspicion. Those already demonstrated include in the order of their importance, *Quaylea whittieri* Gir.; a species of Eusemion, undescribed; *Tetrastichus blepyri* Ash.; three species of Cheiloneurus; *Eupelmus inyoensis* Ash., determined by Gahan; and *Thysanus niger* Ash. The three under suspicion include one Cheiloneurus, one Eupelmine and a Perissopterus determined by Gahan as *mexicanus* How.[1]

Quaylea whittieri Gir. is by far the most important hyperparasite attacking the Aphycus, in California outnumbering by far all of the others combined. Recovered rarely on *Scutellista* previous to the introduction of *Aphycus lounsburyi*, it sprang into prominence immediately the latter became abundant in the field. The Quaylea became so abundant in some districts that at certain seasons of the year they were noted swarming by the hundreds around the tops of the trees on the ends of the new growth. In one case, from fifty selected scale parasitized by Aphycus, two hundred and thirty-three specimens of Quaylea were dissected and only five Aphycus were found to have escaped attack. In innumerable instances the Quaylea demonstrated their ability to parasitize all of the Aphycus, from two to seventeen, within a single scale.

An undescribed species of Eusemion is second in importance as a parasite of the Aphycus. While occurring throughout Southern California to a greater or less degree it has been particularly abundant in Ventura and Los Angeles counties. *Tetrastichus blepyri* Ash. has also been rather abundant in the two counties mentioned. The other secondaries mentioned have been taken only in limited numbers.

It is worthy of note that the secondaries are most abundant in those areas in which the distribution of the Aphycus was most actively carried on, because of the rapidly increased amount of host material available for their attack. In those areas, this season has seen practically every acre treated mechanically by either fumigation or spraying. The Aphycus, however, has not died out in these districts; it is very much

[1] I am indebted to Mr. Harold Compere, Assistant Entomologist, Beneficial Insect Investigations, University of California, for the above determinations. Mr. Compere is preparing for publication a paper covering these hyperparasites in detail.

in evidence, but it has not been able to maintain itself in controlling numbers.

While conditions have made it practically impossible for the Aphycus alone to control the scale in the "uneven-hatch" areas it has been of unquestioned value as an aid to mechanical treatment. Due to the unevenness of the hatch of the scale, fumigation results are not always satisfactory. If the fumigator waits for the last egg to hatch, those scale which hatched out first often develop to a size immune to such treatment. Aphycus, attacking the adult scale during the period of oviposition, which averages approximately sixty days, has destroyed them before egg laying has been completed. This has a marked tendency to even up the hatch and at the same time advance the date of beginning fumigation operations, thus extending what is ordinarily an altogether too short fumigation period. Scale development is so rapid under coast conditions that many of the Aphycus which escape the fumigation in the pupal stage, are able to bridge the short gap as adults and parasitize those scale which owing to their size escaped the treatment.

Interior or "Even-hatch" Conditions

While the State Department of Agriculture was confining its liberations of the limited amount of Aphycus available for distribution to the coastal areas, the growers in those areas were passing on their enthusiasm to those of the "even-hatch" areas together with a large number of parasites. These were enthusiastically received in spite of the Department's warning of an entirely different field condition to be met and a certainty from the results of early experiments that very little should be expected of them. Evidence of the faith of some growers in the reports which filtered into the newspapers is found in the following short, concise letter received at the State Insectary at Whittier from a grower in one of the farthest inland citrus districts. The letter follows:

"Gentlemen:—

Please send me sufficient Aphycus for eight hundred acres and oblige,

Very truly yours,"

The "even-hatch" areas embrace the interior sections which have a much wider seasonal temperature range and much lower humidity than the coastal sections. By far the greater part of the citrus acreage in Southern California lies within these areas. It was early found that the single uniform generation of scale in these areas limited the period of attack by the Aphycus to approximately two and one-half months in the spring. It is necessary that control be obtained before oviposition by the scale, for the reason that if the scale were allowed to reproduce

itself it would not again be susceptible to attack that season, the Aphycus would largely die out and the new season would begin with as heavy an infestation as the previous one. Strictly speaking the Aphycus would not entirely die out each season, as it has been found that there is always more or less off-stage scale throughout the year on certain of its more succulent host plants, sufficient to carry over a small number of Aphycus from one season to the next.

It has been determined that February 15 is the earliest possible date at which scale of a size suitable to the attack of Aphycus could be found under these conditions. It was thought that if a sufficient number of Aphycus could be liberated at this early date, there would be sufficient time to secure control through the two or possibly three generations which laboratory experiments indicated were possible in the period before the beginning of egg laying by the scale. Field work however soon demonstrated that the prevailing temperatures at that season of the year so retarded the development of the Aphycus, particularly in the pupal stage, that it was practically inactive until after reproduction by the scale had started. One citrus association expended $50,000 this season in an effort to place a sufficient number of parasites in its orchards to offset the short period of effective attack. Though they were able to liberate between five and ten million Aphycus during the spring months, over their properties, they did not succeed in obtaining the desired results. Under these conditions it is obvious that in the "even-hatch" areas the Aphycus can never, by itself, control the black scale. But while this is true, the Aphycus offers other possibilities of value, as in the "uneven-hatch" areas. As a body parasite of the third or "rubber" stage and the ovipositing adult itself, the Aphycus assists in completing a sequence of enemies attacking the black scale, filling a gap between the ladybird, *Rhizobius ventralis*, and *Scutellista cyanea*. This sequence offers a possibility of control under proper handling.

One of the faults of Scutellista has been that almost always it has matured before oviposition by the scale has been completed, with the result that many eggs have escaped destruction and a heavy infestation of scale has followed in spite of an abundance of this parasite. The Aphycus materially increases the efficiency of the Scutellista by attacking the ovipositing adult scale and reducing the period of egg laying, thus making it possible for the Scutellista to consume all of the eggs deposited. That the Aphycus and Scutellista are socially inclined is shown by the frequent finding of both attacking one scale. In one

instance five Aphycus pupae were removed from the body of an adult black scale and three Scutellista pupae were taken from the egg cavity.

BIBLIOGRAPHY

HOWARD, L. O. On some new parasitic insects of the subfamily Encyrtinae. Proc. U. S. National Museum, Vol. 21, 1898, pp. 241, 248.

SMITH, HARRY S., and COMPERE, HAROLD. The life history and successful introduction into California of the black scale parasite, *Aphycus lounsburyi* How. Monthly Bulletin, Calif. State Dept. Agri., Vol. 9, 1920, pp. 310–320.

SMITH, HARRY S., Biological control of black scale in California. Monthly Bulletin, Calif. State Dept. Agri., Vol. 10, 1921, pp. 127–137.

SMITH, HARRY S., Biological control of black scale, *Saissetia oleae* (Bern.), in California. Journal Econ. Ent., Vol. 14, 1921, pp. 348–350.

COMPERE, HAROLD. Seasonal history of the black scale and its relation to biological control. California Citrograph, Vol. 6, 1921, p. 197.

THE SUCCESSFUL INTRODUCTION AND ESTABLISHMENT OF THE LADYBIRD, *SCYMNUS BINAEVATUS* MULSANT, IN CALIFORNIA

By HARRY S. SMITH, *University of California, Citrus Experiment Station*[1]

ABSTRACT

A South African ladybird, *Scymnus binaevatus*, after several unsuccessful attempts, has been colonized on several mealy bugs throughout California. There is a prospect of its becoming of considerable value as a check on these pests.

Mealybugs of several species are among the most important pests of horticulture in California, and up to the present time they have to a large extent proven resistant to all attempts at control by means of fumigation or spraying. This has made them particularly attractive subjects for control by the biological method; several valuable parasites and predators have been introduced into California for this purpose, and very satisfactory practical results have thus been secured.

Among recent introductions is that of the ladybird, *Scymnus binaevatus* Mulsant, from South Africa.

For several years the writer has been in correspondence with Mr. C. W. Mally, Entomologist for the Union of South Africa, at Capetown, with reference to a ladybird existing there, reported to be of importance as an enemy of mealybugs. When Mr. E. W. Rust, parasite collector for the State Department of Agriculture (now for the University of California) was sent to South Africa, he was asked to secure a colony of this ladybird for use in California. This he did and several shipments were made via Australia, but owing to the long journey none of them arrived in a living condition. When Mr. Rust began his return trip to this country in the fall of 1921 he brought a large colony with him

[1]The beneficial insect work was transferred from the California State Dept. of Agriculture to the University of California on July 1. The introduction described in this paper took place before that time.

as far as Sydney, Australia, where, owing to the necessity of making further investigations in that locality, he placed them aboard a steamer for San Francisco. This shipment like its precedessors was unsuccessful, and immediately upon its receipt Mr. Rust was advised of the situation by cable. He had very wisely left a stock in care of Mr. Mally at Capetown and at once cabled him to send another colony to him at Sydney. This was done and by stopping at Honolulu enroute for fresh food for the ladybirds Mr. Rust was able to reach California with 29 living specimens. These were rushed to the Whittier Laboratory where they were given an opportunity to propagate, which they did so effectively that within a year approximately 250,000 were colonized throughout the state.

Mr. Rust writes as follows with reference to this species:

"In South Africa it is quite commonly encountered and does much beneficial work against various mealybugs, but in its native home it is preyed upon by a parasite which often decimates it, and so keeps it from being as effective a check on its host as would otherwise be the case. This parasite (*Homalotylus africanus* Timb.) gave a great deal of trouble in the insectary at Capetown while material was being reared for shipment to California and it was only by exercising a good deal of patience that the parasite was finally eliminated and a good clean stock of ladybirds built up for shipment. However, this was finally accomplished and the coccinellids were brought to California without their parasite, so here they should increase very rapidly, being free of their hereditary foe."

Scymnus binaevatus is very distinct in appearance from any California species of the genus because of its greatly elongated body. It is blackish in color with a brown spot on each elytron. The larvae are very similar to those of other species of Scymnus, being covered with a white, waxen secretion. This ladybird has the habit of seeking crevices in bark and other hidden places for feeding, a habit which is of especial value in the case of certain mealybugs which would otherwise escape its attack.

This ladybird has been colonized throughout the state, on *Pseudococcus citri*, *P. gahani* and *P. maritimus*. Besides southern California colonies, it has been liberated in the counties of Tulare, Fresno, Kings, San Joaquin and Alameda in northern California. The first field liberation was made in March, 1922. It has since been recovered in the orchards in abundance at Santa Monica, Pasadena, Alhambra, Oxnard, Rivera and San Fernando. As many as 50 adults have been found in a single burlap band. Recoveries so far have been made only in orchards

infested with citrophilus mealybug, but insufficient search has been made in case of other infestations to justify any conclusion that it will not attack the other species. It is believed that this ladybird will become of considerable value in the control of the above mentioned species when it has had sufficient time to become thoroughly established.

Through the courtesy of Dr. L. O. Howard, specimens of this ladybird were studied by Mr. E. A. Schwarz of the National Museum, who reported as follows:

"The small Scymus from South Africa is most probably identical with *Scymnus binaevatus* Mulsant (1850), described (apparently from a single specimen) from "la Cafrerie." The type is now in the Stockholm Museum. Mulsant's description agrees very well with Mr. Smith's specimens but it is not known to me at present whether or not other African species of Scymnus allied to *S. binaevatus* have been described by recent authors. It would be safe, therefore, to refer to the species as "*Scymnus* (*Sidis*) *binaevatus Muls.*?".

THE HISTORY OF HYDROCYANIC ACID GAS FUMIGATION AS AN INDEX TO PROGRESS IN ECONOMIC ENTOMOLOGY

By R. S. Woglum, *Entomologist, California Fruit Growers Exchange, Los Angeles, California*

Abstract

Hydrocyanic acid gas fumigation was discovered in 1886. From 1886–1893 it underwent decided improvement as a fumigant for citrus trees; 1893–1900, greenhouse, nursery stock, stored products and mill fumigation were introduced; 1907–08, orchard fumigation was standardized; 1910–13, sodium cyanide displaced potassium cyanide; 1912, portable machine generator invented; 1913–14, vacuum fumigation developed; 1916, liquid hydrocyanic acid first used for fumigating; 1923, calcium cyanide dust experimented with as fumigant.

The ascendency of American economic entomology during the last half of the 19th century appears attributable primarily to the development of methods which offered noteworthy relief to agriculturists suffering from insect depredations. The maintenance of this supremacy in pest control has rested largely on the discovery of new or the improvement of old methods or practices. The history of hydrocyanic acid gas fumigation during its thirty-seven years of use is peculiarly illustrative of entomological progress. It appears a fitting topic at this meeting as its discovery in 1886 by Coquillett was made in Los Angeles, the first experiments being conducted in the famous Wolfskill Orchard, now displaced by the Southern Pacific Station. Much of the later progress in fumigation has also been made in Southern California.

Coquillett's discovery was the outgrowth of unsuccessful efforts to

control the cottony cushion scale with sprays. In its earliest stages, the gas process was interesting rather than fully practical. The tents were bell-shaped, very heavy, sometimes oiled, and almost gas tight. Very cumbersome equipment was used to move these tents over trees. The process was slow and necessarily expensive. The generation process of concentrated acid slowly dropping onto dry cyanid, or into a cyanide solution was prolonged and somewhat uncertain of uniformity.

By the early nineties, fumigation had undergone vast improvement. The heavy bell-shaped tents had given way to flat octagonal sheets of untreated tightly woven canvas. The advent of flat sheets which could be moved by two poles greatly simplified the covering and reduced the cost of the operation. The simple pot method of generation, which consisted of dropping solid cyanide into a dilute acid had come into use. Day fumigation had given way to night fumigation, which meant less plant injury. The greatest weakness of the system at that time was the lack of an accurate and practicable method of estimating the dosage, and this condition was reflected in one way or another throughout the first 20 years of orchard fumigation, at times receiving no small amount of attention from California investigators, particularly Woodworth. Nevertheless, the system as a whole proved sufficiently satisfactory that it rapidly became the standard of scale-insect control in California, a position maintained up to the present time. From 1893 to 1907, there was no outstanding development in orchard fumigation other than in increased volume of work done. Conflicting ideas between fumigators on dosage, exposure, proportion of chemicals and general procedure, however, became numerous.

The last fifteen years have seen the greatest progress made and the most rapid changes in fumigation since its earliest days. The development by Morrill in 1907 of a practical method of marking tents for the calculation of dosage was the most important step toward accurate orchard fumigation. The writer introduced this marked tent method of fumigation into California in 1908, strengthening it by a dosage schedule adapted to the fumigation of any citrus tree pest against which fumigation is practiced. The superiority of the marked tent system with its sliding scale of dosages rapidly became apparent to growers and fumigators alike and for the last decade has completely supplanted all other methods wherever orchard fumigation is practiced.

Potassium cyanide exclusively was used in fumigating up to 1909. The work in 1908–09 of Woglum and McDonnell showing the availability of high grade sodium cyanide for fumigation formed the basis of con-

version from a potassium to a sodium basis in 1910–1913 when the price of potash products increased. Since 1914, sodium cyanide has dominated the field in all lines of fumigation.

In 1912, William Dingle, a practical fumigator, invented a portable machine for generating gas outside the tent from cyanide in solution. Subsequently a modified type of generating machine known as the cyanofumer was developed in Los Angeles and displaced the pot system very largely in California in 1915–17. Although this new method did not appear superior to the pot method in scale control, it was an improvement in several ways over the more cumbersome pot method from the standpoint of the fumigation manager.

One of the greatest forward steps in fumigation was the development of liquid hydrocyanic acid by William Dingle in 1916. Mally, in South Africa was experimenting in a small way with the same chemical almost simultaneously but entirely independently. The simplicity of the "liquid gas" method, as commonly termed, led to its immediate adoption in California. A combined attack on the problem by entomologists, chemists, manufacturers and fumigators quickly led to the development of a standardized system of liquid gas fumigation with a uniformly high grade product. Today fully 90 per cent of the 2½ million dollar annual fumigation campaign in California comes under the liquid system, the remaining 10 per cent being divided between cyanofumer and pots. Three large manufacturing concerns are now in the field, one making the liquefied product from sodium cyanide, one from calcium cyanide and the other synthetically.

Methods of application have undergone repeated changes and no less than 12 different types of generating machines have been developed and used since the method originated. Some of these machines have been adapted for atomization of the liquid through a mist nozzle while others convert the liquid to gas by heat. A very large amount of valuable data bearing on the limitations of liquid hydrocyanic acid for orchard fumigations has been accumulated. One reflection of this information is the greatly increased practice of daylight fumigation, a decidedly hazardous operation in former days with pot or cyanofumer.

The most recent development in fumigation has been the use of calcium cyanide as a dust. Quayle was the first to use this material for fumigating beneath a tent. At the present time calcium cyanide dust as an orchard fumigant is merely in the experimental stage. Preliminary work appears to have shown it very effective against scale insects but more damaging to plants under certain conditions than cyanide gas

generated after the other methods commonly used. If this injury factor is neutralized, there is likely to be a further change in the orchard fumigation practice. Calcium cyanide has also been tried out as a dust on various plants. Flint, in Illinois, has done considerable work with it against the Chinch Bug. In California, it is being tried against various pests.

My discussion has been confined to a statement of progress largely as illustrating orchard fumigation. There has been great development in hydrocyanic acid gas fumigation along various other lines. Between 1893 and 1900, cyanide gas was successfully used in treating greenhouses, nursery stock, stored products, mills and other buildings. Each of these methods has experienced great improvement and wider application in recent years. No attempt will be made to detail this progress. More recently railway cars and ships have been fumigated successfully.

The development in 1913–1914 of vacuum fumigation by Sasscer and Hawkins opened an entirely new and highly important field. Vacuum fumigation at once supplied a method of destroying insects in products which no other system of fumigation is able to reach successfully. It has been found to be the system of fumigation under which insect eradication is most certain. Its value in plant quarantine is attested by the number of large vacuum plants at American ports of entry for the treatment of foreign products which might contain insect pests. In California a number of small plants have been installed for treating nursery stock, stored products, et cetera. Vacuum fumigation is assured a great future and its development is proceeding rapidly, especially under the guidance of the Federal Horticultural Board. In California, Mackie of the State Department of Agriculture has made decided progress in the treatment of nursery stock and stored products.

The environment of insects, as well as of plants, at the time of fumigation has a decided influence on efficiency in insect destruction as well as injury to the plant. Valuable data bearing on the influence of various factors, such as wind, temperature, moisture, sunlight, Bordeaux mixture, physiological condition of the plant, have been and are being developed by entomologists and others, thereby increasing the certainty of insect destruction and reducing the hazard to the plant.

THE WHITE SNAIL (*HELIX PISANA*) AT LA JOLLA, CALIFORNIA

By A. J. Basinger, *University of California,*[1] *Citrus Experiment Station*

Abstract

Helix pisana, a European snail, became established in California and measures were taken to eradicate it. In Europe this snail is a pest of citrus trees. Observations at La Jolla, California, verified this. It is also a possible pest among other cultivated plants. The average number of eggs per individual at La Jolla in December 1922, was 120. This is higher than the number given for Europe. The methods employed in eradication were; clearing the ground of vegetation, flaming the cleared areas, use of poison bait of calcium arsenate and bran, and hand-picking. The results were effective and very few *Helix pisana* are left after one year of eradication work.

The white snail (*Helix pisana*) is a European species, native in Sicily and of considerable economic importance in that country as a pest of orange and lemon trees. The fact that this snail had gained a foothold at La Jolla, San Diego County, California was first brought to the attention of California horticultural officials by Dr. L. O. Howard in 1918. Eradication measures were undertaken at that time which resulted in almost complete extermination (1). Inability, however, to keep up the fight against the snails resulted within a few years in an infestation of such magnitude that there was grave danger of the white snail spreading to the citrus areas of California. The Bureau of Pest Control of the California State Department of Agriculture and the San Diego County Horticultural office, in consultation with the U. S. Department of Agriculture then formulated a cooperative campaign to eradicate the pest. Active operations were commenced on July 17, 1922.

Economic Status of Helix Pisana

The economic importance of *Helix pisana* in Europe is given by T. de Stefani (2). He says that the snails feed on the foliage, bark, tender twigs, fruit and blossoms of orange and lemon trees, and on the foliage of almond and olive trees. In La Jolla *pisana* was observed to feed on a great variety of plants, including a small grapefruit tree that was seriously impaired by constant defoliation. In another instance a clump of zinnias in a flower garden made no progress until the snails were destroyed on the premises. The fact that *Helix pisana* feeds voraciously on a variety of plants indicates that it may be a possible pest of crops other than citrus. I have no doubt that it would prove quite damaging to vegetable crops and small fruits as I found it to be fond of the leaves of sweet potatoes, chard, beets and blackberries.

As a nuisance this snail has first rank about a home because it occurs in enormous numbers where conditions are favorable and crawls on and

[1]This paper records the results of work undertaken while the writer was in the employ of the California State Department of Agriculture.

into everything. In La Jolla they became so numerous in places that during the rainy season while the snails were crawling about one could hardly travel on the sidewalk without crunching snails at almost every step.

The Infestation at La Jolla

It is not know how or when *Helix pisana* was first introduced into the United States but one rumor credits a European resident of La Jolla with its introduction for the purposes of a table delicacy. This snail is used extensively as an article of food in France and Italy. It may have escaped from among a collector's specimens, for if taken while sealed with a heavy epiphragm it appears quite lifeless and may, after months, push off the seal and crawl about again. The earliest record of its existence in La Jolla is from some specimens in a collection of shells marked "La Jolla, June, 1914."

When first brought to the attention of the San Diego County Horticultural Office in 1918 the infestation was in the lower end of a canyon that runs through the southern portion of the town, and in a few of the adjoining lots. It covered at that time an area of about three or four city blocks (1). In 1922 the snails had spread throughout the whole length of the canyon and the adjoining properties. They were in twenty-two different city blocks and had a good start also at the Scripps Institution for Biological Research which is about two miles north of La Jolla. In the eradication work it was necessary to treat about eighty acres. This included a margin of safety beyond the actual infestation.

Throughout a large part of the infested area the white snails were present in astonishing numbers. They were on virtually everything—houses, fences, bridges, curbings, trees, telephone poles, shrubbery, weeds and rock piles. In the summer they were sealed fast to the various objects waiting for the rainy season. Only in places that received water regularly was there any action among the white snails in the dry summer. McLean (1) counted 798 snails on a small wild buckwheat bush less than two feet across. In a garden plot 16 by 19½ feet we took out 6690 snails. This was about 21 per square foot and represented a fair average for much of the infested area.

Life History and Habits

Helix pisana is a member of the Pulmonata, a group which comprises the air-breathing Gasteropods. The typical shell is light buff with lineal brown stripes. The variation in shell color ranges, however, from white to buff with no marking of any kind to those having as many as fourteen lineal brown stripes. The usual size of the adult shell is one-half

to three-fourths inch in greatest diameter. The body is light cream to dark gray and in the adult has an extension of one and a half to two inches. As there is no operculum the aperture is sealed with a temporary epiphragm during drought or other unfavorable conditions.

This snail is hermaphroditic and mutual fertilization is necessary for reproduction. Mating begins in the fall when the first rains come and oviposition follows from a few days to several weeks later. At La Jolla mating under natural conditions was first observed November 9 after a good rain had fallen during the night. The first snails were found ovipositing on November 30 after several days of wet weather. When ready to lay eggs the snail digs a hole in the ground about one and a half inches deep and enlarges the lower end to form a cavity for the egg mass. As the genital aperture is at the anterior end the snail does not withdraw its body from the hole until the entire process of digging and egg laying is finished. The soil is dug loose by the lips and jaw and worked out along the lower side of the foot in a flat ribbon onto a little conical pile to one side of the shell. The eggs are deposited singly but adhere to each other as they emerge, forming a mass that looks much like a white blackberry. They are spherical, about two millimeters in diameter and milky white. When through laying eggs the snail withdraws from the hole and carefully closes it at the top with mucus and bits of soil, and then crawls away. The whole process requires several hours. According to T. de Stefani (2) each adult oviposits but once in a season; however, as the generations overlap, egg laying continues from the beginning of wet weather in the fall to the dry season in the spring. He gives the number of eggs deposited by a single individual as from fifty to seventy. At La Jolla in December 1922 the number of eggs in twelve egg-masses ranged from fifty-two to two hundred and twenty-six. The average was one hundred twenty. The number of eggs would no doubt vary according to the age and size of the snail and perhaps also with weather conditions.

The time of hatching, of course, depends on favorable temperature and moisture. In Europe T. de Stefani says it is twelve to sixteen days. At La Jolla it was about three weeks. Eggs laid on the last of November hatched about December 20. The newly hatched snails have a very thin shell of one and a half whorls. The adult snail has five whorls and a fairly hard shell. Shortly after hatching the young begin to feed on the tender plant growth in the vicinity of the nest. Of the snails hatched on December 20 the largest one was about three-eighths of an inch across at the end of fourteen weeks. Besides feeding on nearly all kinds of

green vegetation they also eat such materials as weathered wood, paper and earth.

Methods of Eradication

In eradication work against this pest the first step taken was to clear off all the vegetation, excepting trees, in the canyon and open lots throughout the infested area. Heavy eye hoes were used for this purpose and everything was cut down to the bare ground. It was then worked into piles or windrows where it was left to dry for several days before burning. Leaving the ground bare made an extremely unfavorable condition for the snails, as it reached an uncomfortable temperature during the heat of the day. The disturbance caused by the hoeing stirred the snails into action and many took refuge in the windrows where they were later burned.

Following the clearing of the open areas they were next burned over by a flamer. The outfit for this work consisted of a power sprayer with distillate as the fuel. Nozzles producing a fine spray were mounted on 16-foot iron rods. The distillate was forced through the nozzles and the spray set on fire. The effect was that of an immense blow torch. The flame was played over the ground leaving in its wake a black, barren waste. Of course, some snails under stones and in crevices and other protected places escaped the direct flame and were not killed. However, they were easily picked up later by hand as the disturbance caused them to crawl about and they could be readily located by their slimy trails on the black ground. Two line of hose each seventy-five feet long were operated from the spray rig. This was necessary in order to reach the remote parts of the canyon. Several times it was necessary to join the 75-foot lengths into one in order to flame distant parts.

While the open properties were being cleared and flamed we were carrying on a series of experiments to determine the best means for eradicating the snails from about the many dwellings where we had to deal with lawns, flowers, shrubbery, trees and vegetables. We had no intention of applying the devegetating and flaming process about these places except, possibly, as a last resort. Fortunately our efforts were successful,. for in the use of calcium arsenate and bran as a bait we found one of the most effective measures in the fight against *Helix pisana*. This poison bait was adapted from Lovett and Black (3), who used calcium arsenate and chopped lettuce leaves as a control for the gray garden slug in Oregon. We used it in the proportion of one part of calcium arsenate to sixteen parts of bran. It was first mixed dry and then water added until a moist but not wet mash was obtained. Nothing

else was added. It was scattered over the infested area as in sowing grain. Before the winter rains came we were able to get the snails into action by sprinkling the treated areas with garden hose. The snails fed readily under these conditions. During the rainy season the entire infested area was treated twice with the poison, once in the fall and once in the spring. In our trial plot, which consisted of a garden 16 by 19½ feet, we secured in six days a kill of 92.46% of all snails present. There were 6,690 snails in the plot but of this number 259 were still sealed up. This gave us a kill of over 96% of all active snails. The results in our practical applications were fully as satisfactory. It might be well to state here that the brown snail (*Helix aspersa*) also feeds readily on this bait and the poison is highly recommended for that pest.

In spite of the apparent thoroughness with which the clearing, burning, and poisoning were done, it was still necessary to supplement by hand-picking in order to get the few that persisted in remaining sealed up. Hand-picking also had to be resorted to in getting the snails from underneath buildings, from fences, bridges, and other places where we could not use fire or poison.

Progress of the Eradication Campaign

The progress of the eradication campaign at the end of the first year has been such that even the careful observer in La Jolla no longer sees a white snail. A year ago there were millions of them and people came from neighboring towns to see them clustered in great masses on the weeds and shrubbery in the infested area. In the last ten weeks four live white snails have been found by inspectors from the San Diego County Horticultural Office. While the progress has been more than we thought possible in a year it no doubt will take several years of frequent and careful inspections and treatment before the white snail is entirely stamped out at La Jolla.

Literature Cited

1. McLean, Robert R. "Snail pest at La Jolla, California." Cultivator, Vol. 58, No. 22, p. 593. June 3, 1922.

2. De Stefani, T. "*Helix pisana* and the damage it is capable of doing to citrus trees." Nuovi Annali di Agricoltura Siciliana. Anno 2, N. S., Fasc. I, 1913, Palermo. Translated by Harry S. Smith. See California Citrograph, Vol. 8, No. 2, pp. 35, 56, 57. Dec. 1922.

3. Lovett and Black. "The gray garden slug." Oregon Agric. Exp. Sta. Bull. 170. June 1920.

Chairman R. E. Campbell: Two papers have been submitted by members who could not be present and will be read by title as follows:

BEES VS. SPRAYING

By R. W. Doane, *Stanford University*

Much has been said and much written on the subject of bees being poisoned when near-by trees were sprayed while in blossom. Most of these complaints come from the bee-men, themselves, and investigations have sometimes shown that the death of the bees was due to other causes. Several articles written by entomologists and others have, when analyzed, been found to be based entirely on reports made by beekeepers. But Bulletin 247 of the Purdue University Agricultural Experiment Station, published in 1920, contains an interesting account of very definite experiments conducted by W. A. Price, to determine whether the bees could be affected in this way and to determine the amount of arsenic necessary to kill a bee.

Because the results he obtained in these experiments were so very different from a series that I conducted about the same time and in somewhat the same way, it may be of some interest to record the results of my observations.

On April 15, 1919, I sprayed an apple tree that was almost in full bloom with arsenate of lead, using 3 lbs. of the arsenate of lead to 50 gals. of water and using 8 gallons of this spray to the tree. The spray was applied with a pressure of from 150 to 200 lbs., especial effort being made to fill the calyx cups as far as possible. The tree was then covered with a cabinet made of a light wood frame that was covered with a good quality of gauze. In order that there might be sufficient room on each side of the tree the cover was made 18 x 18 x 16 ft. high. The cloth, while fairly firm was light enough so that the activities of the bees inclosed therein, would not be interfered with.

On April 17, in the evening, a moderately strong colony of bees was placed beside the tree under the cover. On the morning of April 18, 2 gallons more of the spray was applied to the tree. This time the spray was applied as a very fine mist, the leaves and petals being well covered in this way. The screen that closed the hive was then removed and the bees were allowed to fly around inside the cover. Within a short time some of them were visiting the blossoms, apparently feeding; before noon scores of them were feeding freely. A number of the bees flew directly to the top of the cabinet and tried to escape and during the whole course of the experiment some bees were to be seen along the upper corners trying to get out. On the morning of the 19th the bees that had remained outside of the hive over night were chilled and not able to fly. Some of them had dropped to the ground and were crawling

about feebly, but very few dead ones were found. During that day and the following day the bees were watched carefully and their activities seemed to be perfectly normal. At the end of the second day the bees were taken back to the apiary from whence they came. About 125 dead bees were found inside the cabinet and 65 live bees that had not found their way back to the hive, were also collected. These were placed in separate vials to be submitted to a chemist for analysis to determine whether they would show any traces of arsenic.

On the afternoon of April 21 with the owner of the bees, I made an examination of the colony that had been returned to the apiary. We found them working in an apparently normal way and we found that they had been storing honey during the two days that they were in the cabinet. All of the larvae seemed to be in normal condition; a number of cells were open and it is to be presumed that the larvae were being fed during the time of the experiment, otherwise they would have died. The queen had been laying eggs, and there was nothing about the colony to suggest any unusual conditions. I may add here that this colony was observed from time to time during the following year and no unusual conditions were noted.

On April 22, in order to check the first experiment the cabinet was placed over another tree near the one that had been sprayed for the first experiment. This tree was about the same size and shape and in about the same condition as regards blossoming as the tree used in the experiment. We then selected another colony of bees that corresponded as nearly as possible in every way to the colony that had been placed under the cabinet in the first experiment. This colony was placed under the cabinet with the tree that had not been sprayed and their behavior carefully noted. The first ones that came out flew about uneasily for awhile, many of them flying to the top of the cover where some of them stayed. Many of them soon began to feed on the blossoms and in a short time they were feeding in a perfectly normal way. In the evening it was noted that a number were still clinging to the top of the cover, a few were found dead on the ground, and a few were crawling about in the grass. There was some brown spotting on the top of the hive and on a strip of cardboard placed on the ground in front of the hive; similar spots to these were seen during the progress of the first experiment, and there seems to be nothing abnormal about these spots. The number we found is doubtless due to the fact that the bees could not fly far away and any droppings from them would, therefore, be more numerous in the inclosed space and so more conspicuous.

The bees were under observation until noon the next day. During this time the bees in this check experiment behaved in the same way as the bees that were used in the first experiment. All the dead bees that could be found were then gathered up and placed in a vial in order that they might be submitted to the chemist for analysis, to check the analysis made on the bees taken from the cabinet when it was over the tree that had been sprayed.

When the chemist submitted his report after he had analyzed these bees, it was found that the dead bees that were collected in the cabinet at the end of the first experiment, contained .00000255 grams of arsenic per bee. The bees that were collected while they were still alive during the first experiment, showed .000002 grams per bee. The bees that were found dead in the cabinet when it was used for the check, contained .0000006 grams of arsenic per bee.

In making these tests the bees were counted and weighed and then placed in beakers and digested with nitric acid followed by sulphuric acid. The arsenic was then determined by the well known Gutzeit method, a blank on the chemicals was run with the samples.

These analyses showed that the difference between the content of arsenic in the bees that were exposed to the arsenic and those that were not exposed, was so minute as to be inconsiderable.

It must be remembered that all plant and animal substances contain quantities of arsenic, so that careful analysis made at any time will always show a trace.

In the spring of 1920 I began another series of experiments in which I sprayed the trees while they were in full bloom in order that I might test the effect of such a spraying on bees and thus check up the experiments conducted in 1919. On April 12, 1920, two apple trees were sprayed with arsenate of lead, using 6 lbs. of arsenate of lead to 50 gals. of water. About 5 gallons of the spray was applied to each tree and care was taken to drive the spray into the calyx cups as much as possible. As there was a little mildew on these trees some atomic sulphur was used in the spray. Many of the blossoms on one of the trees were gone; the other tree had at least half of the blossoms on it and a number of bees were visiting the blossoms evidently feeding. In another part of the yard a pear tree, which was in full bloom, was sprayed with the same material. As this was a small tree all of the blossoms were easily available and it was given a good thorough spraying.

On an adjoining lot was a hive of bees, situated about 25 ft. from the

pear tree and about 100 ft. from the apple trees that were sprayed. The bees that were feeding on the trees at the time the spraying was done were passing to and fro from this hive. On April 19 the same trees were sprayed again; on this day I used dry acid arsenate of lead at the rate of 4 lbs. to 50 gals. of water, and added to this dry Bordeaux mixture, using the latter at the rate of 6 lbs. to 50 gals. of water. There were still a few blossoms on one of the apple trees and many on the pear tree. During the interval between April 12 and 19 I had an opportunity to watch the bees as they were coming from and returning to the hive on the lot near the sprayed trees. As far as I could determine they were in normal condition.

On April 17 I placed a hive with a fairly strong colony of bees in it, under one of the apple trees on an adjoining lot where there were five or six apple trees blooming. The hive was kept closed for 24 hours and when it was opened in the evening a great many bees came flying out but within an hour most of them had reentered the hive or had settled on it close to the entrance. The next day a number of dead bees were found on the canvas that was spread in front of the hive. These were all brushed away; I found later that some dead bees were still being carried out; these bees had doubtless died because the hive was closed for such a long time. On April 19 I selected two of the trees that were closest to the hive and gave them a very thorough spraying with arsenate of lead, using 6 lbs. of arsenate of lead to 50 gals. of water, and applying 5 gallons of the spray to each tree. These trees were in full bloom, a few of the petals were just beginning to fall. Care was taken to drive the spray into the calyx cups as much as possible. A third tree which was much larger and which was just coming into full bloom, was sprayed with dry acid arsenate of lead, using 4 lbs. of the arsenate of lead to 50 gals. of water. About half of this tree was sprayed with the coarse spray, an attempt being made to drive the spray into the calyx cup as usual. The other half was sprayed with a fine mist, an attempt being made to cover all of the blossoms and the leaves with this fine mist. The spraying was continued until it appeared that the leaves were covered with all of the material they would hold without dripping.

When I began spraying, the bees from the hive were feeding on the blossoms in great numbers; most of them were driven away by spray material but within ten minutes of the time the spraying was stopped, a number of them were back on the tree again, so their feeding was interrupted for only a short period. The day was sunny and fairly warm although a slight breeze was blowing intermittently. This work was

done with a small hand-power spray pump and a pressure of 150 to 175 lbs. was maintained. During the next ten days I watched the bees and the trees very carefully and then took the colony back to the apiary from whence it came. During the time that the bees were in the orchard no unusual conditions developed. The bees had been working actively and while a few dead bees had from time to time been found on the cloth spread outside of the hive, the number had not been more than one would expect to find around a hive at this time of the year. An examination of the hive at intervals after it was returned to the apiary showed that the bees and the brood were in good condition and that the bees had stored a good deal of honey during the time they fed in the small apple orchard.

It is a common practice among the bee men of Santa Clara Valley to lease their bees to orchardists for the blossom period, some orchardists paying as high as $2.00 or even $3.00 a colony to have the hives placed in various parts of their orchards. No restrictions are made as regards spraying and it is a well known fact that California orchardists are enthusiastic sprayers. One prominent bee-man told me that when he first began this practice of renting his bees for use in the orchards he feared that he might lose some of them when the trees were being sprayed as he had heard that bees were sometimes poisoned in this way. But as year after year went by and he noted no bad results from having his bees in orchards where they were spraying with arsenical and other sprays, he came to pay no attention to it at all.

In the Pajaro Valley, one of our important apple-growing sections, the orchardists begin to spray very soon after the apple blossoms appear and continue to spray for several weeks so the bees have every opportunity to feed on sprayed blossoms over a long period, yet we do not have any reports of spray injury to bees in that section.

A real California booster would say "It's the climate!" Possibly it is.

SOME ASPECTS OF BIOLOGICAL CONTROL IN HAWAII

By D. T. Fullaway, *Entomologist, Hawaiian Board of Agriculture and Forestry*

The use of natural agencies for keeping insect multiplication within bounds, which the term "biological control" connotes, has proved a most successful method of dealing with injurious insects in the Hawaiian Islands, and has been of great economic value. Artificial methods of control, on the other hand, have given generally poor results. The reason of this is found in peculiar conditions here, which I shall attempt to describe.

Nearly all of our pests are immigrant species, and many of them have become established in Hawaii without the checks upon their multiplication which exist in the lands from whence they came. The climate here also is conducive to the rapid multiplication of insects. The temperature rarely falls below 60 degrees Fahrenheit in the lowlands. Hence, it is possible for the development of insects to go on without interruption, and six to eight cycles annually is not unusual for many species. Hibernation phenomena are scarcely discernible. Again, a luxuriant vegetable growth furnishes an ample supply of good.

In these circumstances, adaptable species reach excessive numbers in a very short time, occupy the land to the extent of available food, and generally become a scourge on improved land. Artificial methods of control are inadequate to the situation, usually not giving the desired results and involving excessive expenditure to get even poor results.

On the other hand, all the conditions cited as favorable to the excessive multiplication and rapid dissemination of injurious forms, likewise favor the use of natural agencies for their restraint. The introduction of beneficial insects can be undertaken at any time of the year, their propagation and colonization are greatly facilitated by the abundance of host material and the absence of a dormant season, which in more northern latitudes often seriously hampers biological work. The peculiar nature of our insular fauna is also a favorable circumstance here, the paucity of forms operating to make the incidence of hyperparasitism less likely.

Finally, the character of our agriculture is also a favorable circumstance. I mean to say that the bulk of our production is limited to a comparatively few crops, grown under field conditions over large areas, and the business of production is highly organized. These features all work advantageously. In the first place, the limited scope of the work makes it a possibility as far as the time element is concerned. Secondly, centralized management and adequate support are essential to expensive work involving a high degree of technical skill and sustained effort. Thirdly, the effect of a small improvement is rendered disproportionately great when the application of it is extensive.

In stating that our work along the lines of biological control has been successful, I do not wish to be understood to imply that the success has been uniform in degree or that the establishment of a beneficial species has succeeded from every introduction made. Quite the contrary has been the case. The consignments received from our collectors which have produced results are few in number when compared with the total

number of consignments made, and the results have varied to a very high degree, from the perfectly satisfactory control of *Anomala orientalis*, achieved through the introduction and establishment of a single enemy, *Scolia manilae*, to the fruitless search for wire worm enemies, which has extended over four years. An entirely satisfactory control of the sugar cane leaf hopper has only been achieved after twenty years' work, involving the introduction of more than a score of enemies. The control of the Mediterranean fruit fly has not been entirely satisfactory owing to the fact that the larvae occur in many fruits with a thick pulp, where the parasites which are effective to a high degree in thin-pulped fruits, cannot reach them. Recent introductions to improve the control of the avocado mealy bug, *Pseudococcus nipae*, have given marvellous results in a very short time, but in the case of other coccid species the control exerted by parasites and predators has been less marked.

A perplexing question in our experience with this work has been, Should all the obtainable enemies of an injurious species be introduced or should a complex be avoided and dependence put upon one effective enemy. I believe this, in the light of our experience, is still a debatable question.

I realize that in this hasty survey of the subject I have only skimmed its surface, but I have been warned of a time limit. In conclusion I would add that if the application of this method to the subjugation of an insect pest does not always result in a full and complete control of the pest, it at least often brings its multiplication within such bounds that artificial methods can be used with some degree of satisfaction. Also, that the main defect of the method from a practical standpoint appears to be its limited application.

Afternoon Session, September 19, 1923

R. E. CAMPBELL, *Chairman*

JOINT MEETING WITH ECOLOGISTS, PLANT PATHOLOGISTS AND PLANT PHYSIOLOGISTS

SUBJECT: Ecological Factors Influencing Distribution and Severity of Insect Pests and Plant Diseases.

Papers were presented by H. S. Fawcett and E. T. Bartholomew, and afterwards discussed by the members present.

A telegram was sent to the members whose homes were burned in the Berkeley fire and included W. B. Herms, H. H. P. Severin and Dr. E. C. Van Dyke, all of the Entomology Division, University of California.

The meeting was adjourned to meet next year with the Pacific Division of the American Association of Economic Entomologists at the place to be announced later.

A SIMPLIFIED METHOD FOR MAKING LUBRICATING OIL EMULSIONS[1]

By A. M. Burroughs and W. M. Grube, *University of Missouri, Columbia, Missouri*

Abstract

A method is described by which stock emulsions of paraffin oils used in spraying are made without heat and without the use of potash fish-oil soap. Freshly made bordeaux mixture or copperas-lime mixture, calcium caseinate, saponin and other substances were used as emulsifying agents in the place of soap. The oil, water and emulsifying agent were placed together in a container and pumped twice under fairly high pressure. The emulsions made in this way were used successfully on a large scale. They gave as good results against San Jose scale as the emulsions made with potash fish-oil soap, and were cheaper and easier to prepare. These emulsions did not break down in the presence of hard water or water contaminated with lime or lime-sulphur.

In the past few years there has been a marked increase in injury to apple trees from San Jose Scale in northern Arkansas, southern Missouri, and southern Illinois. The standard dormant spray of strong lime-sulfur solution has failed to give control in some cases. In an effort to control scale more cheaply and efficiently, the Bureau of Entomology of the United States Department of Agriculture tried out the lubricating oil emulsions used against citrus scale in Florida. Experiments carried out by Ackermann[2] at Bentonville, Arkansas, in 1921–22, indicated that a 2% emulsion of engine oil was effective against San Jose Scale on apple trees. As a result of his work, a large number of orchards in Arkansas, Missouri, and Illinois have received dormant applications of this spray during the spring of 1923.

The formula and methods for preparing the emulsion are given by Yothers[3] and Quaintance.[2] This is generally known as the "Government Formula" and is given below:—

Engine Oil	2 gal.
Potash Fishoil Soap	2 lbs.
Water	1 gal.

The oil and the solution of soap in the water are mixed and heated to the boiling point, and pumped twice through a pump giving 60 lbs. pressure. Further directions and details are given in the publications referred to above. This method has given good results at the Missouri

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[1]Contribution from the Departments of Horticulture and Entomology, University of Missouri. The authors wish to express their appreciation of the advice and help received from the members of these two departments, and especially from Mr. O. C. McBride of the Dept. of Entomology.

[2]U. S. Dept. of Agriculture Clip Sheet 193, 1922.

[3]U. S. Dept. Agriculture Farmers Bulletin 933, 1918.

Experiment Station, and has been successfully used by many growers in the State. Other growers have had trouble in getting good emulsions. Emulsions made according to the Government Formula have been put on the market by spray companies, and in some cases the growers have been advised to buy these rather than make their own.

It has been stated that the oil-soap stock emulsion made according to the Government Formula contains $66\frac{2}{3}\%$ oil. This is not the case. To make stock emulsions containing $66\frac{2}{3}\%$ oil by volume, the following formula has been used here:—

Engine Oil	2 gal.
Potash Fishoil Soap	2 lbs. (about 1 qt.)
Water to make total of	3 gal. (about 3 qt.)

We have been able to make good emulsions using 1½ lb. of soap instead of 2 lbs. as in the above formula. These stock emulsions of oil and soap, containing 59–67% oil, mix freely with soft water, and are added to a tank of water in proper proportions. However, if mixed with hard water, lime-sulphur, or any mixture containing an appreciable number of calcium ions, spontaneous de-emulsification occurs. This is due to a reaction between calcium and the potassium soap, with the formation of a calcium soap. A calcium soap tends to stabilize emulsions of water in oil, rather than of oil in water. Under working conditions, however, de-emulsification occurs rather than a change of phase. Oil-soap emulsions can be "stabilized" for use with hard water and lime-sulphur, by the addition of glue, casein, flour, starch, etc.[3] A ½-½-50 Bordeaux mixture has been widely utilzed as a stabilizer when hard water has to be used.

Following the work of Pickering,[4] emulsions have been made up at the Missouri Agricultural Experiment Station in the cold, using Bordeaux mixture, and a mixture of ferrous sulphate and lime as emulsifying agents. Calcium caseinate, sold under the trade name of "Kayso" has also been used successfully as an emulsifying agent, as well as powdered saponin and extract of soap bark. Such emulsions have been made up in considerable quantity, and used in spraying over 300 bearing trees. No statement can be made in this article as to the expediency of replacing lime-sulphur by oil emulsions for the dormant spray. However, the success attained in preparing and applying these emulsions, it is believed, warrants the presentation of the method of preparation. A comparison of the results obtained with such emulsions and those made according to the Government Formula is also given.

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[4]Journal Chemical Soc. 91: 2001, 1907.

The engine oils used in Florida are residual oils, with a specific gravity of around .90. They boil between 300° C. and 400° C. The brands of oil used in this work were "Paraffin Diamond" and "Red Engine Oil," purchased from the Standard Oil Company of Missouri. Paraffin Diamond is the type of oil used in oiling floors. Red Engine is somewhat heavier, and is used as a cheap, low quality lubricant. When using what he called finely divided solids as emulsifying agents, Pickering used "solar distillate" a residual oil boiling between 240° C, and 350° C, and having a specific gravity of .858. In many respects this resembled the paraffin oils used recently in the United States.

In Pickering's work, Bordeaux mixture, or ferrous sulphate-lime mixture was made up according to the Woburn formula; that is, with no excess lime present. The desired percentage of oil was added directly and the mixture emulsified by pumping it back on itself by means of a "garden syringe." We have made stock emulsions by a number of formulas. Four of the most satisfactory ones are given below:—

FORMULA NO. 1

Engine Oil	2 gal.
Tap Water	1 gal.
Copper sulphate	¼ lb.
or	
Ferrous Sulphate	¼ lb.
Quick Lime	¼ lb.

FORMULA NO. 2

Engine Oil	1 gal.
Tap Water	1 gal.
Copper Sulphate	½ lb.
or	
Ferrous Sulphate	½ lb.
Quick Lime	½ lb.

FORMULA NO. 3

Engine Oil	2 gal.
Water	1 gal.
Kayso	4 oz.

FORMULA NO. 4

Engine Oil	2 gal.
Water	1 gal.
Saponin	4 oz.
(or extract from ½ lb. soap bark.)	

To make the emulsions with Bordeaux or iron sulphate-lime mixture, add to the oil the required amount of the metal salt, dissolved in one-half the water required, and add the lime in suspension in the remainder of the water. Mix a little, then pump the mixture into another receptacle by means of a bucket pump. A Bordeaux nozzle adjusted to give a fine spray is desirable. To make emulsions by means of Kayso, suspend it in water, add it to the oil, and pump as before. The Kayso is best wetted by adding water slowly and stirring, until a paste or dough is formed, then diluting until the required amount of water is present. When saponin is used it is merely stirred up in the water, the oil added, and the mixture pumped back and forth.

Other methods or formulas in preparing the emulsions may give equally as good results. Considerable force must be used in the pumping. We generally pump the emulsion at least twice. If Bordeaux or iron sulphate-lime mixture is used as an emulsifying agent, it must be freshly made. Bordeaux is useless for the purpose after it has stood

for a short time. These stock emulsions can be made by means of a power sprayer. The ingredients are put in a half barrel or other container and the suction hose and a hose from the return line placed in the container. The mixture is then pumped from one receptacle to another until emulsified.

The emulsions made in the manner described above have larger oil globules than the oil-soap emulsions. Those made by means of the basic metal hydroxides have a tendency for a little oil to separate out after a time. This can be emulsified again by re-pumping. The emulsions so made do not separate spontaneously in the presence of hard water, lime-sulphur, or in containers contaminated with lime or lime-sulphur, as do the soap emulsions.

When diluted with water, the emulsions tend to rise to the top, but can be kept properly mixed by the degree of agitation obtained in a power sprayer. By emulsifying the oil with a relatively large amount of Bordeaux or iron sulphate-lime mixture, an emulsion can be made which is heavier than water, and which can be more easily kept stirred by the agitators. If the right proportions are used, an emulsion with a specific gravity of 1 can be made. Pickering[4] gives the formula for such an emulsion of solar distillate.

Pickering believed that, where the so-called insoluble emulsifiers were used, the oil globules were surrounded by minute solid particles of the emulsifier. Text books,[5 6 7] give other explanations of the action of emulsifying agents in general, but most of them mention that Pickering's emulsions are exceptions to the general rule.

Holmes[5] describes the ideal emulsifying agent as a solvated colloid giving a tough elastic film, gelatinous and swollen on the side of the continuous phase (water) and coagulated and slightly wetted on the side of the dispersed liquid (oil). The proteins, alkali soaps, and the other hydrated colloids which can act as emulsifying agents for engine oils, fulfil the requirements of this theory. Holmes evidently believes that the emulsions made with Bordeaux mixture differ from those having hydrated colloids as emulsifiers. Yet Duggar and Bonns[8] consider dried Bordeaux films to be capable of hydration. Collodial metal hydroxides are able to hold in combination a large amount of water. Clay was one of Pickering's "solid emulsifiers," yet under some conditions, clays are highly hydrated. It may be that the basic sul-

[5]Holmes, N. H. Laboratory Manual of Colloid Chemistry. N. Y., 1922.
[6]Bancroft, W. D. Applied Colloid Chemistry, N. Y., 1921.
[7]Clayton, W. The theory of Emulsions and Emulsification. Philadelphia, 1923.
[8]Annals of Mo. Botanical Garden, 5: 153, 1918.

phates of iron and copper, when freshly prepared, act as hydrated colloids, and fulfill the requirements of a good emulsifying agent, as given by Holmes. Pickering obtained good emulsions with solid emulsifiers only when they were freshly prepared and in the medium in which they had been precipitated. He failed to get satisfactory emulsification with previously dried materials, even when they were very finely divided. In the light of the modern conception of the colloid condition as a state in which any substance may exist, it seems unnecessary to make an exception of Pickering's emulsions.

It has been stated[9] that oil-soap emulsions should not be used with Bordeaux, due to change of phase and liberation of free oil. We have seen no signs of such liberation of oil when the soap emulsions are added to freshly prepared Bordeaux. A ½–½–50 Bordeaux mixture has been widely used as a stabilizer when oil-soap emulsions are to be used with hard water. Other substances, such as starch, flour, glue, casein, and calcium caseinate, which are used to stabilize oil-soap emulsions in the presence of the calcium ion, can be used as emulsifying agents. It seems probable that the so-called stabilizing material forms a film around any unprotected oil particle present. These oil particles may be gotten into the presence of the hydrophile colloid chemically, by destruction of the soap film, or mechanically, by breaking up by means of a spray.

The reason why only freshly prepared Bordeaux mixture is efficient as an emulsifying agent is somewhat obscure. This property is probably dependant on the degree of dispersion of the basic copper sulphate. Coagulation goes on rapidly in Bordeaux, due to the presence of two flocculating agents, lime and gypsum. If Pickering's views are correct, it may be the increased size of the particles which prevents their acting as an emulsifying agent. If we assume that the Bordeaux acts as a solvated colloid, the decrease in hydration due to coagulation may prevent emulsification. A parallel to the latter hypothesis exists in the case of skim milk. Fresh skim milk makes good emulsions for a time, but clabbered skim milk, where the casein has coagulated and become less hydrated, is not a satisfactory emulsifying agent.

It is not within the scope of this paper to discuss the advisability of replacing lime-sulphur with engine oil emulsion as a scale spray. It may be said, however, that in the Middle West 2% engine oil emulsified according to the Government Formula, is considered to be an efficient

[9]Mahin, E. G. and Carr, R. H. Quantitative Agricultural Analysis, New York, 923.

scalecide. Comparisons have been made of emulsions made according to various methods, as to control of San Jose Scale and the grain aphis. The results are given in the following tables:—

Table I. Effect on San Jose Scale of 2% Diamond Paraffin Oil Emulsified By Various Methods

Emulsifying Agent	*Number Counted*	*Percentage Killed*
Potash Fish oil Soap	815	96.2%
Kayso	1168	97.8%
Saponin	1043	98.5%
Bordeaux Mixture	1317	95.7%

Table II. Effect on the Grain Aphis of 2% Diamond Paraffin Oil Applied in the Delayed Dormant Stage. (Under Laboratory Conditions).

Emulsifying Agent	*Number Counted*	*Percentage Killed*
Potash Fish oil Soap	316	92.0%
Kayso	287	96.2%
Bordeaux Mixture	941	90.0%

These counts give evidence that the efficiency of the oil is little affected by the nature of the emulsifying agent. The emulsions of oil with Bordeaux, Kayso and saponin seem to have been as effective as emulsions made according to the government formula. The differences in the percentage of control are probably due to experimental error. The degree of control of aphis under field conditions varied with the time of the application and care used in spraying. In one case, 2% oil-Bordeaux emulsion was applied in a heavily infested orchard when the buds were just opening and the aphids were clustered on the green tips of the buds. Under these conditions 96% control was obtained. The results against the grain aphis suggest that the cold emulsions might be a valuable means of control of more serious aphis pests.

The emulsions made according to methods given above promise to be as valuable as the oil-soap emulsions, and are somewhat cheaper and easier to prepare. One hundred gallons of 2% oil emulsion cost from 34c to 48c depending upon the emulsifying agent used. Bordeaux and iron sulphate-lime emulsions are the cheapest. Not having any soap in their composition, they are compatible with Bordeaux, lime-sulphur and lead arsenate, and can be used with hard water.

A REFRIGERATOR FOR SHIPPING LIVE INSECTS[1]

By John N. Summers

The satisfactory shipping of imported parasites of the gipsy moth from the countries where they are obtained to the United States Bureau

[1]Mr. A. F. Burgess suggested the ice cream shipping tub as being best adapted to our needs.

of Entomology Laboratory at Melrose Highlands, Mass., has long been attended with considerable difficulty. With those species which can be obtained safely in the hibernating stage the problem is comparatively simple, but with others the summer broods have to be collected as either they use hibernating hosts which would be dangerous to import or they can only be obtained in satisfactory numbers during the summer. Some of these species may be handled best by collecting and shipping the parasitized gipsy moth larvae while with others we collect the cocoons or the puparia. To insure safe arrival the host larvae must be kept alive until the parasites issue and the parasite adults must be prevented from emerging en route. In either case refrigeration is necessary for without it the host larvae will only live for a short time and as the pupal stage of the summer broods of parasites is short, the adults will emerge and die long before they reach their destination.

The successful importation of parasites is therefore dependent upon proper refrigeration en route. This can be obtained for the trans-oceanic part of the route by having the boxes placed in the cold storage rooms of the vessels, but no such facilities are available on land. Our difficulty lay in getting suitable refrigeration for long overland shipping, particularly for the shipments of parasites which were sent from Japan. As speed was a vital factor, all such shipments were sent by express. Although the company handles considerable amounts of perishable produce it does not own any small refrigerators as all of these belong to the individual shippers. At times it is possible for the company to borrow one of these small refrigerators but it is not certain that one will be available when needed. Therefore we were compelled to secure some of our own to insure that they would be at hand to receive our shipments.

Information about the various types of small refrigerators in use was obtained. Of these, the type used in shipping ice cream appeared to be the best for our purposes. Its weight when iced was not excessive and as it is in general use express employees are familiar with it and would be almost certain to give one the proper attention. We had to avoid the danger of having the water from the melting ice penetrate to the parasites, which might result if the refrigerators were placed in any position but upright. With the ice cream shipping tubs there would be small danger of this owing to their shape and to the fact that they are familiar objects.

Refrigerators of a ten gallon capacity were obtained, these consisted of heavy metal cans eleven inches in diameter and twenty-four inches

high enclosed in heavy wooden tubs. These tubs were thirty inches high, nineteen inches in diameter at the bottom and twenty-one inches

Fig. 6—Component Parts of Refrigerator and Shipping Box (Photo by Hood)

in diameter at the top. The tubs did not possess covers so they were fitted to heavy wooden ones which were padded around the edge to make them as tight as possible and prevent the rapid melting of the ice and the escape of the cold air. To the center of each cover on the inside a small padded wooden block was attached which pressed down on the handle of the can cover to keep the latter securely in place. To prevent the can being thrown around inside and insure an even layer of ice around it, it was held centered at the bottom by three or four small wooden blocks and at the top by a pair of iron straps which were attached to the tub at the sides and were tightened around the can by means of two bolts.

When the tubs were purchased there were vents in them which would allow the water to drain off. These were plugged so that the water would remain until the refrigerators were re-iced, as it would remain cold for some time and prevent the warming up of the contents.

The boxes in which the parasites were to be shipped were of the same type which has been found to be so satisfactory for this purpose, i. e.

a number of light wooden ones enclosed in a heavier wooden box and, of a size to fit the metal containers of the refrigerators. The large boxes were constructed of half inch stock and measured 7½ x 7½ x 22¾ inches. Each one of these was fitted with six small boxes measuring 3½ x 6½ x 6½ inches, constructed of quarter inch stock. For convenience in removing the parasites and to guard against the escape of any, which might occur if it was necessary to remove the covers of these small boxes, an inch hole was bored in one side of each one. This hole was covered by tacking over it a square of tin which could be removed for the insertion of a glass tube when the shipment arrived.

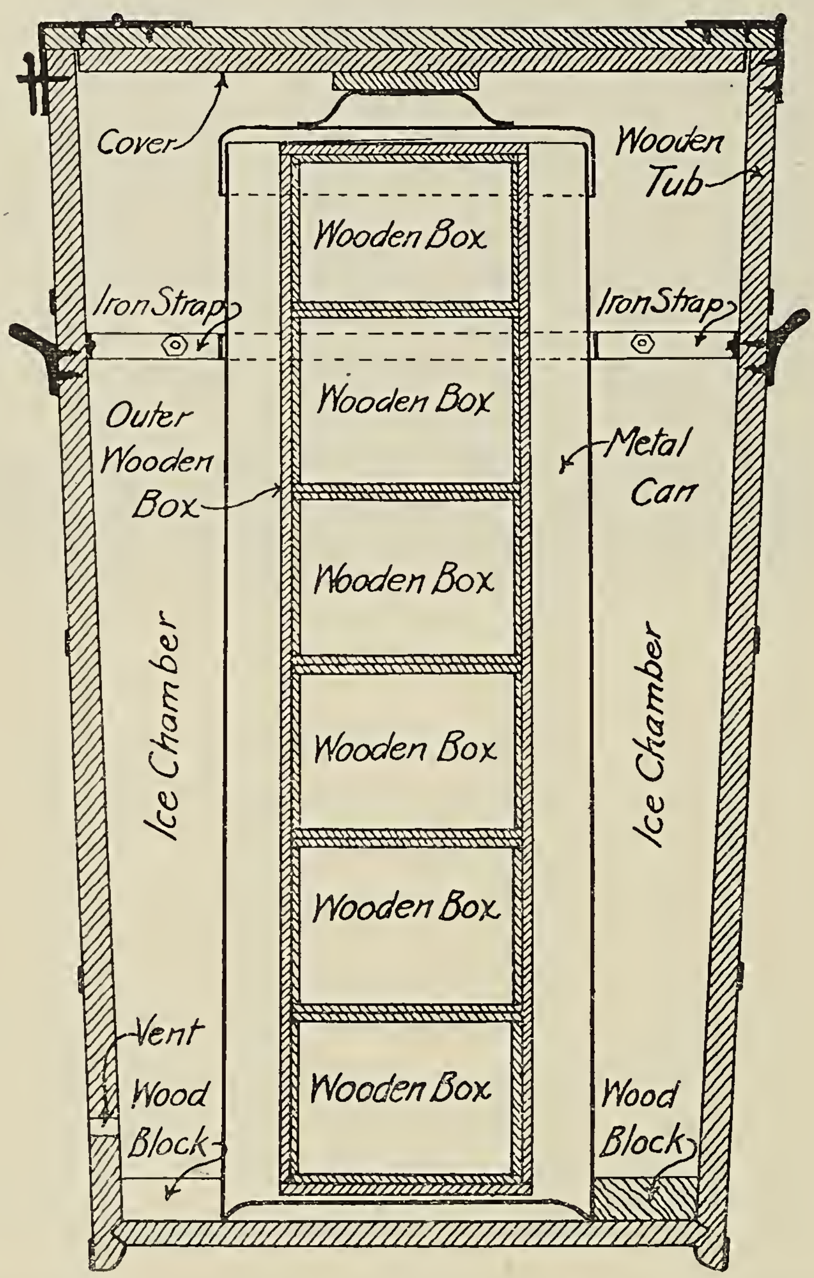

Fig. 7—Diagram of Refrigerator and Shipping Box Assembled (By Guild)

The refrigerators received a very good testing the past summer from a shipment of *Apanteles fulvipes* from Japan. This species is a difficult one to ship over a long distance as its cocoon stage is only about six days, which makes proper refrigeration absolutely necessary. Boxes for shipment were constructed in Japan. Two of these were packed with

parasitized gipsy moth larvae when the first *Apanteles* larvae were beginning to issue, and shipped from Yokohama on May 19, in the cold storage room of one of the fast Trans-Pacific vessels. The boxes arrived at Seattle May 29 and were placed immediately in two of our refrigerators which were on the dock all iced ready to receive them. As the refrigerators were cold there was no opportunity for the parasites to suffer from a rise in temperature. The two refrigerators were immediately started for Melrose Highlands and were re-iced once en route. The shipment arrived at our Laboratory June 5, having taken eighteen days from Japan. On arrival the shipment was unpacked immediately. All of the ice had melted but the water was very cold. About five per cent of the host larvae were alive and active. The parasite larvae had issued from their hosts and spun their cocoons but none of the adults had emerged. *Apanteles* adults began to emerge shortly after arrival and continued for several days, every cocoon producing a vigorous adult.

The refrigerators were also tested for the shipment of live larvae. A collection of web worm larvae, *Hyphantria* sp., was made at Seattle, packed in one set of boxes and shipped August 11, to Melrose Highlands in one of the refrigerators, taking seven days to reach there, being re-iced once en route. The shipment was in good condition on arrival with about half of the larvae alive and vigorous. Results were very good considering the fact that it was not possible, owing to limited facilities, to exercise quite the care in packing necessary to get the best results.

Much of the success of such shipments depends upon the care used in packing. When parasitized larvae are sent too many must not be placed in each box; with the gipsy moth we pack from fifty to a hundred, depending upon their size, and plenty of small branches of foliage must be included. The foliage serves two purposes,—it provides food for the larvae, and prevents them from being thrown against the sides of the box and injured. If parasite cocoons or puparia are sent it is usually best to pack these in layers separated by sheets of paper but some experimenting may be necessary to determine the best way.

The small boxes should be lined with blotting paper to absorb the moisture precipitated when the temperature is lowered otherwise there will be an excess of moisture and the growth of mold.

The illustrations were made by Messrs. C. E. Hood and I. T. Guild of the Gipsy Moth Parasite Laboratory, and the method of holding the can in place devised by Mr. H. I. Winchester.

THE PINK BOLLWORM OF THURBERIA, *THURBERIPHAGA CATALINA*

By J. L. Webb, *Entomologist, Southern Field Crop Insect Investigations, Bureau of Entomology, Department of Agriculture*

Abstract

The pink boll worm of *Thurberia* constitutes a great menace to the cotton grown in the valleys of Arizona below the range of *Thurberia*. An account of the rearing of the adult is given, including notes on parasites of the larval stage. A list of other *Thurberia* insects collected by C. H. T. Townsend is also included.

During the summer of 1913, Dr. W. D. Pierce and Dr. A. W. Morrill made an investigation of the insects associated with the Thurberia plant in several localities in Arizona. In their published report[1] they make mention of "the Thurberia Boll Worm" and give brief descriptions of all stages except the adult which was at that time unknown.

In December of the same year, E. A. Schwarz and H. S. Barber investigated the status of the Thurberia plant and the newly discovered Thurberia boll weevil, *Anthonomus grandis thurberiae* in the mountains of southern Arizona.

Besides the weevil they found abundant evidence of the infestation of Thurberia bolls by a species of bollworm which they called the "pink bollworm." Both these men expressed the view that the pink boll worm (of Thurberia) constituted a greater menace to the cotton grown in the valleys below the range of Thurberia than did the Thurberia boll weevil.

In August 1918 Dr. C. H. T. Townsend was sent by the Bureau of Entomology to the Santa Catalina mountains near Tucson, Arizona, for the purpose of rearing the adult form. His report follows:

"Permanent camp was made August 14, 1918, in the upper end of Sabino Basin, Altitude 3,550 ft. This camp was well situated for the work, being surrounded by Thurberia not only close by but also in all directions at both higher and lower levels. The plant was noted from 3,000 ft. up to 4,800 ft. in Sabino Canyon and around the sides of the Sabino Basin. Above 4,800 ft. it was not found anywhere, the pinyon beginning at that level. The altitudes were taken by aneroid.

Pink Bollworm of Thurberia.

Four hundred forty infested bolls were collected from August 28 to October 4, the bulk of these being found during the last two weeks of September. Not counting a number of worms that escaped from time to time from the rearing receptacles, 142 bollworms were secured from these bolls.

Twenty-two of these worms transformed to pupae in the earth. These were taken with great care from the earth October 13 and packed in cotton in vials for transportation to Washington.

The 142 bollworms yielded 41 hymenopterous parasites, belonging to at least 3 species as follows:

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[1]Washington Ent. Soc. Vol. xvi, pp. 14–23.

Apanteles[2] n. sp.	32
Microbracon n. sp.	7
Perisierola n. sp.	1
Microhymenopter undet.	1
Total hymenopt. parasitism	41

The above is a parasitism of nearly 29%.

In addition to this parasitism, which may yet be increased by muscoid parasites issuing later from the pupae, from 5% to 10% of the infested bolls containing worms are opened by the Southwestern jay, *Aphelocoma* sp., probably the form known as *Sieberi arizonae* Ridgway.

Thus some 35% of the worms appear to be destroyed by natural enemies in the Sabino Basin region, at the least estimate, or well over one-third.

The 22 pupae will, I hope, yield the adult this season, so that the species may be identified. A single specimen of a moth found in one of the insectaries, which had crawled in during the night and may have been attracted by the odor from the Thurberia bolls, was determined by Dr. Dyar as *Perigea continens* Edw. It is a noctuid and about the right size for the Thurberia bollworm moth, but may have nothing to do with it.

The worms in the bolls were extensively attacked, both dead and alive, by two or more species of Phorids while in the insectaries. These phorids are attracted to all fermenting substances, and the frass from many worms assembled in small space is probably the cause of their appearance in great numbers in the rearing receptacles. They accounted for the large mortality in the worms. If the receptacles were covered tightly enough to exclude them, the air was also excluded. As they were not met with in the bolls in the open, they are not taken into account as a control factor.

Other Thurberia Insects

Anthonomus thurberiae Pierce—Found frequently in all stages.

Dichomeris deflecta Busck—Many evidences found during August.

Inglisia malvacearum Ckll.—This scale was found in abundance on two plants at 3,550 and 3,800 ft.

Cecid leaf-gall—Very abundant about the first of September.

Thyanta perditor Fab.—Adult found sucking green boll at 4,100 ft.

Sphyrocoris 2 n. spp.—Nymphs found sucking green bolls at 3,800–4000 ft.

Formica fusca guava Buckley—A perfectly constant attendant on the Thurberia plants everywhere. No plants found without them. I did not see the species elsewhere.

Eriophyes sp.—Bad infestation of plants in patches at 3,500–4,000 ft.

Acridiid sp.—Greenish-yellow nymphs found on Thurberia on half dozen occasions at about 3,500 ft. Not seen elsewhere.

Many bees and *Acmaeodera* sp. were collected in the flowers; *Cardochilis* n. sp., *Cryptocephalus* sp., on the foliage; Gen. Nov. aff. *Stenophasmus* sp. on an infested boll, and *Lygaeus belfragei* Stal on boll.

The hymenoptera were det. by Gahan and Rohwer; coccid by Morrison; heteroptera by Gibson; ant by Mann.

C. H. T. Townsend."

Upon arrival in Washington the 22 pupae of the bollworm mentioned

[2]This species has been described as *Apanteles thurberiae* Muesebeck, in Proc. U. S. Nat. Mus. Vol. 58, pp. 507–508.

in Townsend's report were divided into two lots of 11 each. One lot was sent to T. C. Barber at Brownsville, Texas, and the other to J. D. Mitchell at Victoria, Texas.

Mr. Mitchell's rearing records are as follows:

Oct. 29, 1918,—pupae received at Victoria, Texas.
Aug. 2 to 8, 1919,—3 moths emerged.
Aug. 27, 1919—1 moth emerged.

The following are Mr. Barber's records:

Aug. 6, 1919,—	1	moth	emerged.
Aug. 23, "	1	"	"
Aug. 26, "	1	"	"
Aug. 29, "	1	"	"
Sept 1, "	1	"	"
Aug. 28, 1920,—	1	"	"

It will be noted from Mr. Barber's records that one individual remained in the pupa stage for practically two years.

Specimens submitted to Dr. Harrison G. Dyar were determined by him as representing a new genus and species of the family Noctuidae, Acronyctinae. He described it as "*Thurberiphaga catalina.*[3]

NOTES ON THE BIOLOGY OF *DESMOCERUS PALLIATUS*

By Glenn W. Herrick, *Ithaca, N. Y.*

Abstract

The cloaked knotty-horn beetle (*Desmocerus palliatus*) lives on the common wild elder and attacks the Golden elder which is used for ornamental purposes. The eggs have been found attached to leaves of the elder but it is questionable if this is normal. The larvae bore into the stems of the elder, just above and below the surface of the soil. The larvae pupate in the spring in their burrows in the stems and the adults appear during the last of May or early June. The beetles feed sparingly on the leaves before ovipositing.

This beetle, commonly known as the cloaked knotty-horn, is a native species and evidently widely distributed in the United States and it occurs in Canada. It has been recorded from Ontario, Canada, and in the United States from Massachusetts, Connecticut, New York, Pennsylvania, and New Jersey southward to Virginia, North Carolina, and Louisiana and westward to Indiana and Kansas, at least. Its original food plant is apparently the native elder (*Sambucus canadensis*) on which the beetles are often found in considerable abundance. For example, Mr. Morris in one of his delightful accounts of a collecting excursion, says, "in the little glade, among the thickets of elder, I captured seven specimens of this beautiful beetle in about an hour—always on the underside of the foliage or crawling on the stems****.

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[3]Insecutor Inscitiæ Menstruus. Vol. VII, p. 188.

That season I took over seventy between June 20 and July 25, nearly always on early elder growing in woodland glades and generally on the foliage." The writer has taken the beetles at Ithaca on both the golden elder and the common wild elder. I have also collected it on the wild elder at Deposit, N. Y.

The beetle has been present here at Ithaca for some years on the golden elder used in lawn plantings. The larvae have proved to be seriously injurious to this very useful and beautiful shrub, greatly marring its symmetry and beauty by reason of the dead and dying branches that occur here and there throughout the growth.

The larvae work at the bases of the stems partly above ground but mostly below the soil. Their burrows run nearly parallel with the long axis of the stem and are usually packed full of castings. From six to eight inches above the soil the stems are full of the exit holes of the beetles while the interior is often riddled with burrows of the larvae.

The larva is creamy-white and when full-grown and extended is fully an inch in length and some specimens exceed an inch. The head is brown and the mandibles black in color. The prothorax is wide and flattened and each of the first seven abdominal segments bears a flattened area on the dorsal side reminding one of the much more prominent callosities on the dorsal sides of the segment of the larva of *Mallodon melanopus*. The pupa is slightly more than three-fourths of an inch in length and its appearance is well shown in plate 7.

The adults begin to appear here at Ithaca in June. My notes record one adult on June 14 and another on June 18. On June 13 I found three adults that had transformed in the larval burrows in the stems below ground but had not yet emerged. In the cages to which larvae were transferred on March 30, adults emerged (4 of them) as early as May 30 (1910). It is probable that the transformations of these specimens were accelerated somewhat by the unnatural conditions in which the larvae found themselves and perhaps the temperature was somewhat higher in the cages than in the portions of the elder below ground.

The beetles feed to some extent on the foliage of the elder, eating inward from the edges and producing notches in the leaves. One female was present on the plant and her activities followed for a little more than a week. The male was present on the 23rd of June and the two were in copulation at this time.

On June 14 I found what I supposed were the eggs deposited by another female present on the foliage. I had expected to find the eggs white in color and supposed they would be deposited on the bark near the bases

of the stems. The bodies which I took to be the eggs were deposited on the leaves on their sides and were fusiform in shape, of a clay-yellow color and the surface of each one was longitudinally wrinkled. They are well shown in plate 7. On June 16, 1921 I took several of the beetles on the common wild elder at Deposit, N. Y. These beetles were confined in tumblers with leaves of the elder for a day or two until time could be found to care for them. During the night of the 18th the beetles deposited several of the fusiform, clay-yellow wrinkled eggs in the tumblers identical in shape, size and appearance with those found on the leaves to which reference has already been made. On the 19th four more eggs were laid by one of the beetles. I did not, however, succeed in getting any of them to hatch. The eggs are about 3 mm. long and 1 mm. in diameter.

It is quite possible that the larvae may be destroyed by the use of paradichlorobenzene, applying it in the same manner as it is applied to control the peach-tree borer. I am inclined to think, however, that the gas might be more effective if the crystals were applied in the spring during the latter half of April rather than in the fall.

RED BUG CONTROL IN SOUTHERN PENNSYLVANIA

By J. R. Stear, *Assistant Entomologist, Penna. Bureau Plant Industry, Harrisburg, Pa.*

Abstract

The hatching period of the bright red bug, *Lygidea mendax*, in southern Pennsylvania comes so late in the blossom pink stage of nearly all varieties of apples that the pink spray is ineffective in control. A comparison of pink with the petal fall spray on the York Imperial, a late blooming variety, gave little difference in control. Two applications of nicotine gave no additional control. On earlier blooming varieties the petal fall spray would prove much more effective. One application of nicotine at petal fall is advised.

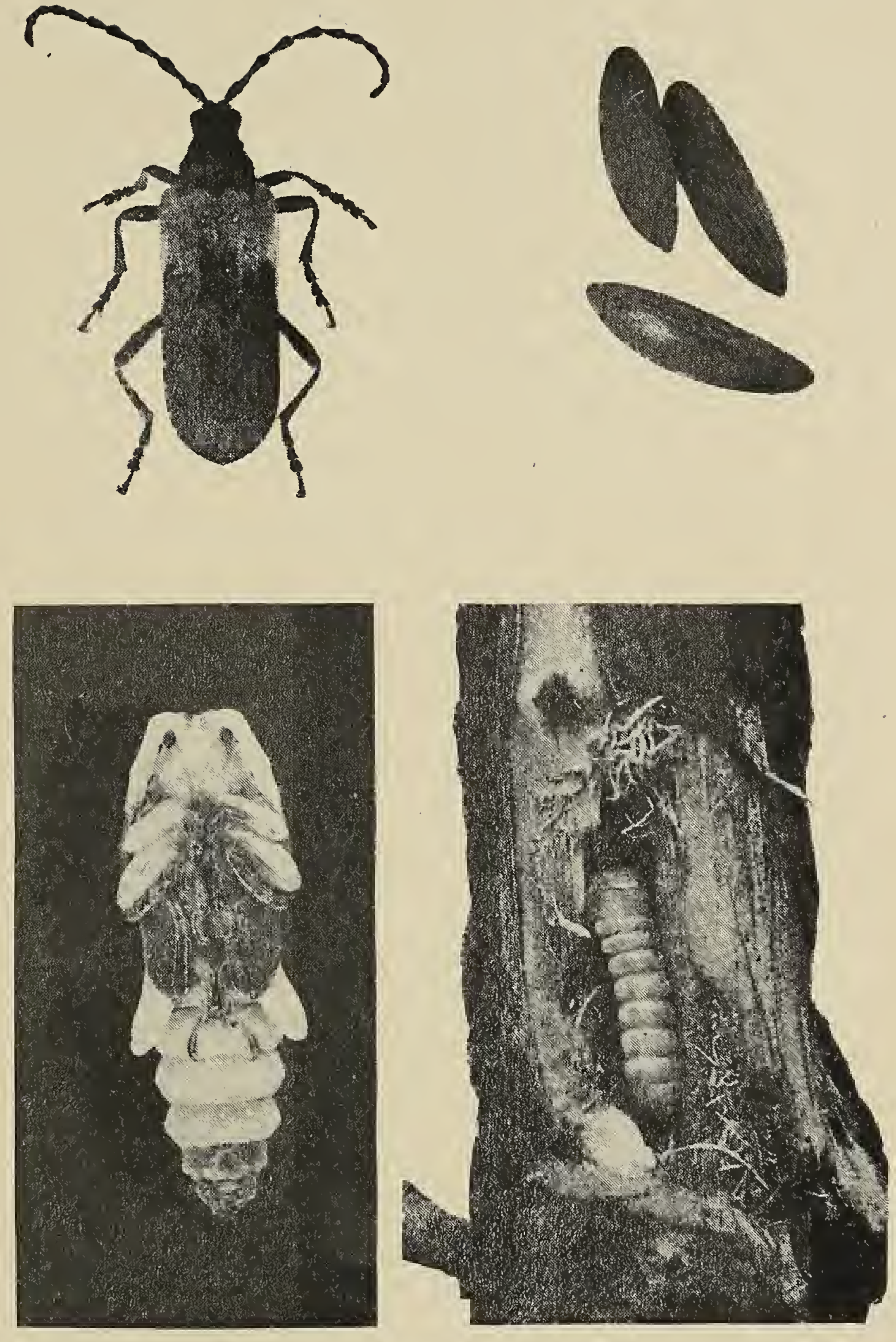
The species of red bug considered in this article is known as the false or bright red bug.[1] In southern Pennsylvania it is the species responsible, so far as observed for all injury to apples. The dark red bug,[2] thus far has not been collected or reared from apples at the Chambersburg laboratory.

The usual recommendation for red bug control, calling for a nicotine spray before the blossoms open has been followed in southern Pennsylvania with varying results. Considering this, it appeared desirable to correlate the hatching of the red bug nymphs with the blossoming of several varieties of apples.

In 1921 and 1922, the writer correlated the first hatching of red bugs with the blooming period of several apple varieties, viz., York Imperial,

[1]*Lygidea mendax* Reut. [2]*Heterocordylus malinus* Reut.

PLATE 7



Desmocerus palliatus; Adult, Eggs, Pupa, and Larva in burrow.

Grimes Golden, Stayman Winesap and Jonathan. In 1921 the first nymphs were observed on April 7th, as many as six nymphs being found on a single blossom bud cluster. On this date all four varieties were in condition for spraying in the pink. By April 9th, however, all were partly in bloom except the York Imperial which did not bloom until April 14th. In 1922 the first nymphs were observed on April 23rd. At this time all varieties were in the pink stage, but by April 26th all were in bloom except the York Imperial which did not bloom until May 1st.

From this it appeared that except in the case of the late blossoming York Imperial, hatching occurred so late in the pink stage that the pink spray could not be delayed long enough to catch the nymphs. Even if it were possible to delay the pink spray until a couple of days before the blossoming period, not more than 50 to 75% of the nymphs would be exposed to the spray. In 1923 hatching occurred over a period of 6 days. Twenty-five percent of the nymphs hatched in the last four days of this period, during which time the trees were in bloom.

Frost[3] has shown that the hatching period of *L. mendax* occurs too late for the pink spray to catch many of the nymphs, and recommended that in red bug control nicotine be applied at petal fall and two weeks later rather than in the pink spray.

In order to compare the effectiveness of later sprays with the pink spray, and also to determine whether sufficient additional control is secured to justify two applications of nicotine, experimental spraying was carried on in an infested York Imperial orchard in 1922.

The orchard was divided into four plots which were treated as follows: Plot 1 sprayed in the pink. Plot II sprayed in the pink and at petal fall. Plot III sprayed at petal fall. Plot IV sprayed at petal fall and 2½ weeks later. Check trees were left in Plot I. The trees were twelve years old and 3–3½ gallons of spray were used per tree. Nicotine sulfate was used at the rate of ¾ pint to 100 gallons of dilute lime-sulfur. The pink spray was applied on April 26th, three days after nymphs were first observed. Petal fall spray was applied on May 8th, and the third spray on May 26th.

[3]Jour. of Ec. Ent., Feb., 1922

COMPARATIVE RESULTS OF RED BUG SPRAYS

Plot	Treatment	Tree No.	Total Apples	Red Bug Apples	Per cent Red Bug
I	Pink Spray	1	491	14	2.8
		2	1504	33	2.1
		3	576	4	.69
II	Pink and Petal Fall	1	795	8	1.
		2	354	9	2.5
		3	373	6	1.6
III	Petal Fall Spray	1	126	0	.0
		2	1213	26	2.2
		3	480	4	.83
IV	Petal Fall & Two & half wks. spray	1	138	1	.7
		2	275	4	1.45
	Checks	1	49	7	14.3
		2	838	110	13.1

In averaging up these results we get the following percentages: Pink spray 1.9% Red bug. Pink and petal fall 1.5%. Petal fall 1.64%. Petal fall and 2½ weeks later 1.2%. These percentages are so small and so close together that there is no practical difference in favor of any of the spray treatments. On the basis of these results and assuming careful spraying, we would conclude that a single application of nicotine at petal fall will give excellent control without an additional spray.

It is unfortunate that the experiment could not have included an earlier blooming and susceptible variety such as Grimes Golden. With such a variety the difference in favor of the petal fall over the pink spray should be very marked.

HABROBRACON JUGLANDIS ASHMEAD AS A PARASITE OF *PLODIA INTERPUNCTELLA* HUBN.

By E. R. deOng, *University of California*

The Indian Meal Moth, *Plodia interpunctella* Hubn., in California is commonly attacked by the parasite *Habrobracon juglandis* Ashmead. Parker mentions it under the name of *Habrobracon hebetor* Say as frequently attacking this larva "but not appreciably affecting the infestation in California," (U. S. Dept. Bul. 235, 1915). This parasite was found to be the most abundant and widely distributed of any attacking *Plodia*, in a study of insects of stored products made in 1918 for the State Food Administrator. It was also found to breed upon a caterpillar recently introduced upon peanuts, *Aphomia gularis* Zeller.

The life history data were from insects in close confinement and

without the best equipment for such type of work. The temperature range was from 24° to 30° C. (75° to 86° F.) to simulate natural conditions in the ordinary warehouse of interior California during the summer.

LIFE HISTORY DATA OF *Habrobracon juglandis*

No.	Number of Specimens	Length of egg stage	Length of larval stage	Length of pupal stage	Period from egg to adult
		Days	Days	Days	Days
1	7	2	6	6 to 8	14 to 16
2	2	—	—	7 to 8	—
3	7	2	5 to 7	6 to 7	15 to 16
4	5	3 to 4	4 to 5	10 to 11	18 to 20
5	5	3	4 to 5	—	—
6	8	2	5	—	—
7	6	2 to 3	4	10	16 to 17
8	4	3	5	—	—
9	1	3	4	5	12
10	6	2 to 3	7	—	—
11	3	2	5 to 8	—	—
Average		2.6	5.2	7.4	16

The average development period of *Plodia interpunctella* under California conditions is given by Parker (former citation) at fifty-three days. Comparing this with the average period of sixteen days from egg to adult of the parasite, it will be seen that there is a possibility of three and a partial fourth generation to one of the host.

Oviposition Habits.. The caterpillars frequently recognize the parasite as a possible enemy and may attempt to escape from it. After being stung, however, paralysis occurs in twenty to twenty-five minutes and then from one to three pearly white eggs are attached to the caterpillar. Three parasites were occasionally reared from one mature caterpillar, but in one instance when five eggs were deposited on a single host four larvae matured but only one adult emerged. Many caterpillars that were confined with parasites were stung and paralyzed even though no eggs were deposited upon them. In one instance eleven *Plodia* larvae and one female parasite were confined in a vial and within two hours all the caterpillars had been paralyzed. Some of these were kept for three weeks and at the end of this time they had shriveled up and turned black, but the exact time of death could not be determined.

Oviposition began in one or two days after the adults emerged and continued over a period of from seven to nine days. The total number of eggs recorded from a single parasite ranged from fifteen to twenty-four.

Scientific Notes

Note on the Cotton Boll Weevil in Kansas. On Oct. 10th and 11th I found quite a number of adults and larvae in bolls on cotton in southern Kansas, Montgomery County. This county lies immediately north of Oklahoma, and according to the best information I can get there is considerable cotton growing immediately south of this county.

Specimens of this insect have been submitted to Mr. J. L. Webb of the Bureau of Entomology, who states that they are typical cotton boll weevil.

E. G. Kelly,
Extension Entomologist.

A Mealy Bug on Grape. Grape growers in the vicinity of Lawton and Paw Paw, Michigan, during the summer of 1923, complained of injury to their grapes, caused by a mealy bug. The infected clusters were not only rendered unsightly by the presence of honey dew but the grapes showed a tendency to drop before they were ripe. This left the cluster ragged in appearance and exposed the white cottony egg masses along the stems. The mealy bug proved to be the omniverous species *Pseudococcus maritimus* Ehr., which is known to occur on a number of different hosts.

Eugenia McDaniel,
Research Assistant in Entomology

The Effect of Low Temperatures on the San Jose Scale in Georgia. In taking records on the results of lubricating oil emulsions and other sprays for the control of the San Jose scale, *Aspidiotus perniciosus* Comstock, on peach trees in Georgia, notes were also made on the mortality of the insect from low temperatures. The table below gives in terms of percentages the dead scale insects found on the check or untreated trees of the experiment before and after the cold period.

Date (1923)	Treatment for scale	Minimum temperature	Percent scale dead
Feb. 9	No treatment	36° F	12%
" 16	" "	26° F	27%
" 19	" "	21° F	38%

The above table shows that as a result of the low temperatures there was an increased scale mortality of 26 % on the trees that had received no treatment whatever during the winter for the control of the insect. The minimum temperatures recorded for a four day period were as follows: Feb. 16, 26° F; Feb. 17, 23° F; Feb. 18, 18° F; and Feb. 19, 21° F. These temperatures were unusually low for Central Georgia, and some large female scales and *all crawlers* were killed during the period.

On March 20th, 1923, a minimum temperature of 23° F was recorded in Central Georgia which killed about 20% of the peach blooms, but did not affect the scale mortality to any extent. The minimum on the day before this freeze was 51° F and on the day after 35° F. The low temperature during the second cold period of 1923 in Georgia was perhaps of a too short duration to kill the San Jose scale.

Oliver I. Snapp and C. H. Alden, *U. S. Bureau of Entomology,*
Fort Valley, Georgia

Unusual Damage to the Floors of a House by a Species of Pemphredinid Wasp, Stigmus fulvicornis Rohwer. During the latter part of August 1923 the writer was requested to visit the home of Mr. Ed. Williams in Starkville, Miss. and investigate the damage to his floors caused by what he thought to be ants. After reaching Mr. Williams' home the writer was very much surprised to find a portion of the floor of his porch bearing numerous holes about the diameter of the head of an ordinary pin or slightly smaller. By the side of a number of these holes were small piles of sawdust. Flying in the air above these holes and crawling on the floor here and there were numerous small wasps which on superficial examination might have been taken to be parasites of whatever insect was damaging the floors. The holes in the floor bore a striking resemblance to those of Ipid beetles, in fact the writer would, upon a hasty examination, have concluded that a species of Ipid was the depredator and that the wasps were parasites on them. A very careful examination of several nests proved that the wasps were the cause of the damage and that they were using the floor as a place in which to construct their nests. A number of the insects were secured but they were so immature that no effort was made to have them determined.

With the literature available the writer was able to place the wasp in the genus *Stigmus*. Specimens were forwarded to Mr. S. A. Rohwer, of The United States National Museum, with a request for a specific determination. Mr. Rohwer wrote that the species was nearest *S. conestogorum* Rohwer, but differed from this species in a number of ways, enough to warrant him in calling it a new species, to which he gave the name *fulvicornis* because of its yellowish or ferruginous colored antennae. Mr. Rohwer took issue with the writer in regard to the wasp's ability to construct nests in the floor. He was of the opinion that the wasps were using the holes made by Ipid beetles or else nail holes for their nests. There is no doubt about the wasps constructing holes in the floor as Mr. Williams observed them carrying sawdust-like frass out of their holes. The writer also examined enough of the nests to be convinced that the wasps were solely responsible for the nests and not the wood-boring beetles, as one would ordinarily think.

A review of the literature dealing with the habits of the wasps of the genus *Stigmus* contains no reference to any species of the genus ever having attacked furniture or floors; normally the wasps breed in the stems of plants or twigs of trees but there is a reference to one species having been bred from a gall. It is left for one to speculate as to why this species should attack floors when there were plenty of trees and plants nearby in which it might have constructed its nests. Will this species continue to be a household pest or was this simply a variation in the habit of the wasp?

On September 10th, a further visit was made to the home of Mr. Williams where the writer's attention was called to the holes made in the floor of the dining room and hall. The floor was hard and well preserved, and not soft and punky like that of the piazza. Both floors were of pine but that of the piazza had been subject to weathering, while that of the interior of the house was almost as well preserved as it was when the house was built. After seeing the nests in this type of wood one was more than ever convinced of the wasp's ability to construct nests in other kinds of wood besides soft and decaying lumber. As a rule the nests in the interior of the house were constructed in the soft wood between the hard grain layers but this was not invariable, for a number of nests were observed which penetrated even the hard grain layers. On the porch a count of the nests occurring in one plank was made and it was found that fifty nests occupied this plank, which was about three

inches wide and four and a half feet long. The distribution of the holes in the plank was not uniform but the holes were rather scattered; in some places there were as many as six holes to the square inch, whereas in other places there were only one or two, or perhaps none, in an area equally as large.

One hole, which was examined, extended into the floor vertically for a distance of one-fourth inch when it suddenly turned at right angles and ran parallel with the surface of the floor for seven inches. In this gallery was found a great deal of frass, but no signs of the wasp or its immature stages.

The writer recommended that Mr. Williams treat each of the holes with carbon bisulphide by injecting this material into the holes with a little oil-can or syringe. This treatment to be followed in a couple of days by painting or varnishing the floor.

M. R. Smith,
State Plant Board, A. & M. College, Miss.

The Aldrich Collection of Diptera. The National Museum has recently received as a gift from Dr. J. M. Aldrich his private collection of Diptera. This collection was begun in 1890, and for 28 years received a good share of the owner's efforts; since he went to the National Museum in 1918 it has, however, received no additions. A recent inventory showed it to contain 44,610 pinned specimens and 4,145 species fully named; 534 of the latter were represented by type material. There are some hundreds of undescribed species; and as Dr. Aldrich collected for many years in the Pacific Coast and Rocky Mountain regions, his collection contains many named species not heretofore represented in the National collection.

Dr. Aldrich also donated to the museum his card index of the literature of North American Diptera, begun in 1898 and now extending to about 70,000 references as nearly as can be estimated. With the exception of about 20 hours' work, this is all by the hand of the owner himself, and represents to a large extent his own conclusions from the literature rather than a mere compilation.

In a letter to his chief presenting the collection and index, Dr. Aldrich states that he was deterred from taking this action sooner because the salaries paid by the museum are still on the scale established in 1882 (except for a temporary war bonus of $240), and he did not feel sure that he could continue permanently as one of the curators. Recently, however, under the reclassification act passed by the last congress, the museum staff have been assured of a new pay schedule approximating the requirements of the present time. Science, *October 19, 1923*

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1923

The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication, at $3.00 per page for all matter in excess of six printed pages; in the case of other matter, the maximum of 2,500 words is still operative. Photo-engravings may be obtained by authors at cost.

Separates or reprints, if ordered, when the manuscript is forwarded or the proof returned, will be supplied to authors at the rates given below. Note that the number of pages in a reprint may be affected somewhat by the make-up, and that part of a page is charged as a full page. Carriage charges extra in all cases. Shipment by parcel post, express or freight as directed.

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The association is growing. The increase in membership, the demand for larger publication facilities, the desire for more branches and sections are all healthy signs. There are a number of amendments to the constitution to be acted upon at the coming meeting. Marked changes in the classification of the members are proposed. This matter should be given careful consideration by all interested in the welfare of the organization.

The arrangement of the program is one of the perplexing problems. Some are certain to be inconvenienced whatever plan is followed. There are so many papers and such a multiplicity of overlapping interests, that compromises are inevitable. It is easy to make suggestions. They may work at one meeting and not at another, because the programs may and usually do differ greatly. The large meeting presents problems quite different from those of the smaller gatherings. An increase in the number of branches would assist materially in reducing the congestion of the program at the annual meetings and would permit men to attend entomological sessions who now find it practically impossible to get to meetings. This last means much to the younger men.

It is gratifying to state that abstracts appearing with the published papers appear to be approved "in principle," especially if the editor prepares them. Occasionally a paper is submitted for publication with the abstract. More often a request is necessary and occasionally authors have misinterpreted our letter and assumed that it was proposed to substitute the abstract for the paper. These summaries are valuable to every reader in indicating the nature of the paper. It is presumable that the author knows better than anyone else the contents of his paper. The day is not distant when a paper without an abstract prepared by the author will be regarded as incomplete.

Current Notes

Dr. T. L. Guyton of the Pennsylvania Bureau of Plant Industry received the Ph.D. degree at Ohio State University at its recent Commencement.

Mr. Loren B. Smith has been placed in charge of the Japanese beetle project of the Bureau of Entomology at Riverton, N. J.

Mr. Don B. Whelan has been appointed instructor in entomology at the University of Nebraska and assistant in entomology in the Station.

According to the *Experiment Station Record*, Mr. E. L. Ayers, entomologist and pathologist of the Extension Service of Florida University has been transferred to the Florida Station as agriculturist.

Mr. R. W. Dawson, assistant professor of entomology at the University of Nebraska, and assistant in entomology in the Station, resigned July 1, to pursue graduate studies at the University of Minnesota.

According to *Science*, the Plant Quarantine Station at Yokohama, Japan, was destroyed by the earthquake, but Dr. S. I. Kuwana was absent in Korea.

Dr. L. I. Huber and Mr. C. R. Neiswander have recently been appointed assistants in entomology at the Ohio Agricultural Experiment Station, Wooster, Ohio.

Prof. H. A. Gossard, during October, spent a few days at the Summit Nurseries, Monticello, Fla., where he is interested in a large pecan plantation.

Mr. Herbert J. Pack of the Agricultural Experiment Station, Logan, Utah, is now connected with the department of entomology of Cornell University, Ithaca, N. Y.

Mr. F. C. Craighead who has recently been appointed forest entomologist in charge of Forest Insect Investigations for the Bureau of Entomology, reported for duty September 14.

Dr. Wm. P. Hayes resumed his work at the Kansas State Agricultural College September 1st, after a year's leave of absence spent in study at Cornell University.

Mr. W. J. Gerhardt of the Field Museum, Chicago, spent two days in Washington studying museum equipment, and visited the Division of Insects to consult with various entomologists.

Mr. D. C. Mote, formerly a member of the staff of the Ohio Station, and more recently State Entomologist of Arizona, is now associate entomologist of the Oregon Station.

Dr. W. D. Hunter and Messrs. B. A. Coad and G. A. Maloney of the Bureau of Entomology attended the national boll weevil menace convention at New Orleans, October 25 and 26.

Dr. W. M. Mann of the U. S. National Museum left September 17 for Mexico, to continue his investigations of fruit flies in connection with work for the Federal Horticultural Board.

At Cornell University a new insectary has been completed. It will be used chiefly for research, but will provide facilities for a course on photography and methods of rearing insects.

Prof. B. B. Fulton of the Oregon Agricultural Experiment Station who was recently married, toured the eastern United States and visited the Entomological Department, Ohio State University, his Alma Mater, in August.

Prof. S. W. Bilsing of the Texas A. & M. College has been granted a year's leave of absence and will spend it in graduate study in entomology at Ohio State University.

Mr. J. C. Bridwell, formerly of the Pacific Coast and Hawaii, is now in Brooklyn, N. Y., and visited the Entomological Department of the Agricultural Experiment Station, New Haven, Conn., on October 29.

Dr. M. W. Blackman, teacher of forest entomology in Syracuse, N. Y., spent two days in the Section of Insects, U. S. National Museum, conferring with various workers and studying types of certain scolytid beetles.

Dr. L. O. Howard, Chief of the Bureau of Entomology, has been appointed president of the International Conservation Conference to be held at Honolulu in 1924 under the auspices of the Pan-Pacific Union.

Prof. R. C. Osburn, head of Department of Zoology and Entomology, Ohio State University, spent several weeks during the summer at the Lake Laboratory at Put-in-Bay engaged in research work on the Lake fauna.

Appointments in the Bureau of Entomology have been announced as follows:—H. S. Adair, Mississippi Agricultural College, junior entomologist, pecan insect investigations, Thomasville, Ga.; Luther Brown, Mississippi Agricultural College, plant quarantine inspector, Riverton, N. J.

Mr. D. C. Parman of the Uvalde, Tex., laboratory of the Bureau of Entomology recently made a trip through the Gulf States, investigating various species of insects injurious to domestic animals in that region.

Dr. F. H. Lathrop who received the Ph.D. degree at Ohio State University in June has been placed in charge of a substation of the New York Experiment Station at Highland, N. Y., under the direction of Prof. Parrott.

According to *Science*, Prof. J. W. McColloch of the Kansas State College has been named acting head of the department of entomology, during the absence of Prof. G. A. Dean, who has a year's leave of absence.

Dr. T. J. Potgieter of South Africa took his Ph.D. degree at Ohio State University in June and has started on his return trip by way of England to South Africa where he will engage in entomological work.

Prof. George M. List, chief deputy entomologist, Colorado Agricultural College, spent most of the afternoon of October 4 in the Section of Insects, U. S. National Museum, studying the methods of filing cards and the arrangement of the collections.

Mr. Josef N. Knull for several years connected with the Pennsylvania Bureau of Plant Industry, has been appointed as research assistant to Prof. Herbert Osborn and will combine work in this connection with graduate studies at Ohio State University.

Mr. F. E. Todd of the entomological staff of Arizona Board of Agriculture with his wife visited the Entomological Department, Ohio State University in August. He is inspecting the entomological work at the various state stations and expects to return to Arizona in a few weeks.

The temporary appointment of Mr. Henry L. Viereck has been extended six months from October 1 by the Division of Systematic Entomology, Entomological Branch, Department of Agriculture, Ottawa, Canada. Mr. Viereck will devote his time to the arrangement of the Hymenoptera in the National collection.

Mr. T. J. Naude, graduate student from South Africa at Ohio State University, visited the Experiment Stations at Wooster, Ohio, Geneva, N. Y. and the Entomological Department and Experiment Station at Cornell University during August to inspect the organization and methods employed in entomological work at these stations.

Dr. Albert Hartzell has been appointed to a National Research Council Fellowship under the Crop Protection Institute and will spend the year at Geneva with Prof. P. J. Parrott in investigations with sulphur as an insecticide. He received the Ph.D. degree at Ohio State University in June.

Prof. and Mrs. T. D. A. Cockerell of the University of Colorado, who returned from Siberia in September were on board the steamship Empress of Australia in Yokohama harbor when the earthquake occurred, but they were uninjured. This steamship being disabled, they were transferred to the President Jefferson.

Mr. Morgan Hebard of Philadelphia spent October 19 in the Section of Insects, U. S. National Museum, studying specimens in the collection and arranging for exchanges of various Orthoptera. Mr. Hebard brought with him many specimens of Orthoptera which he had borrowed from the collection for study.

Mr. N. I. Iskander, assistant entomologist of the Egyptian Department of Agriculture, visited the Section of Insects, U. S. National Museum, October 9. Mr. Iskander was especially interested in the collection of Coccidae and in the arrangement of the collections, especially in the tray system, and also in the organization of the work in the Section of Insects.

Dr. W. L. Chandler, formerly a member of the entomological department of the Michigan Agricultural College and Station, and who is a specialist in parasitology, has been transferred to the department of bacteriology in the newly created section of veterinary science and bacteriology of the same institution, where he will continue work on the parasites of food animals.

At the Utah College and Station, Dr. I. M. Hawley, head of the department of zoology and entomology has been appointed acting dean of arts and sciences, and H. J. Pack assistant professor of zoology and entomology in the College and assistant entomologist of the Station has been granted a year's leave of absence for graduate study at Cornell University.

Dr. Waldemar Pospelov, director of the bureau of entomology of the Agricultural Scientific Committee of Russia arrived in the United States in September and has since visited the Bureau of Entomology at Washington, the entomological departments of the Ohio State University at Columbus, Ohio, University of Illinois, Urbana, Illinois, Cornell, Harvard, and the Connecticut Agricultural Experiment Station, New Haven.

Entomological News records the death of the following European entomologists:—William Evans, Edinburgh, Scotland, October 23, 1922; the Reverend Canon William Weeks Fowler, Coleopterist, at Earley, Reading, England, June 3, 1923; A. L. Montandon, Hemipterist, at Jassy, Rumania; M. Paul Mabille, Lepidopterist, at Perreux, France, April 26, 1923; Eugene Boullett, Lepidopterist, and Ed. Blanc, Coleopterist, both of France, dates not given.

Dr. Carlos de la Torre y Huerta, of Cuba, recently visited the National Museum in Washington, D. C., and while there paid a visit to the Division of Insects to renew

his acquaintance with the various members of the section, especially Doctor Mann. Dr. de la Torre has charge of the Natural History Collections in Havana, and supervision over the well-known Gundlach collection.

Mr. M. M. High, of the Bureau of Entomology, who for a number of years has been engaged in the study of truck-crop insects in southern Texas, including the sweet-potato weevil, is planning to transfer his laboratory from Kingsville, Tex., to Poplarville, Miss., where he will be engaged on a study of the new Australian tomato weevil, in addition to completing his biological work on the sweet-potato weevil.

Entomologists from the principal pea-canning States will meet in Washington November 20 and 21 for a conference on the pea aphis. Stock will be taken of the year's developments and plans made for future work. On November 21, several of the entomologists connected with insecticide companies which have been carrying on active work against the pea aphis will join the conference and discuss the development of insecticides for the control of this insect.

Prof. Herbert T. Osborn, who is employed by the Hawaiian Sugar Planters Experiment Station, and who has been collecting parasites in various parts of Mexico for the Hawaiian Board of Agriculture, has had an extension of his assignment to this work and will continue work in Mexico. According to reports from Honolulu, some of the importations he has forwarded have proven very successful, especially parasites of the pineapple mealy bug, which was causing serious losses in the pineapple crop.

On October 4–6, Mr. L. S. McLaine of the Entomological Branch, Ottawa, Can., was present at a gipsy moth conference held in Albany and visited a new outbreak which has recently been discovered in Alburgh, Vermont. The infestation is on the peninsula at the north end of Lake Champlain and is only half a mile from the Quebec border. It is regarded as very serious and additional scouting will be carried on in Quebec immediately north of the infestation.

The Diamond Jubilee Meeting of the Entomological Society of Ontario was held at Ottawa, Canada, November 1st, 2nd and 3rd. There was a good attendance and a most interesting program. The Gipsy Moth and the European Corn Borer were given special places on the program. The address of President Morris, given in connection with a very pleasant dinner, was an inspiration to all students of nature. The United States were represented at the meeting by A. F. Burgess, who delivered the popular address, and by M. D. Leonard, H. L. McIntyre and E. P. Felt of New York State.

Mr. C. F. W. Muesebeck of the Gipsy Moth Laboratory, Melrose Highlands, Mass., has spent about four weeks in the Section of Insects, U. S. National Museum, identifying parasites and studying the Braconid genus Microbracon. Mr. Muesebeck has devoted considerable time to this difficult genus and hopes to be able to complete the revision of the North American species the coming season. Before returning to his headquarters at Melrose Highlands, Mass., he visited the collections in Philadelphia and also those in New Haven, to examine types.

A conference on the European corn borer was held at the laboratory of the Bureau of Entomology, 10 Court Street, Arlington, Mass., on September 28, followed by a trip to infested fields in the vicinity. The following entomologists and administrative officers were present: Arthur Gibson, L. S. McLaine and R. C. Treherne, Dominion of Canada; Commissioner of Agriculture Truax and R. Faxon, Columbus, Ohio;

C. H. Hadley, Harrisburg, Pa.; M. P. Zappe, New Haven, Conn.; G. A. Dean, Washington, D. C., L. H. Worthley, D. J. Caffrey and D. W. Jones, Arlington, Mass.

A conference called by State Director of Agriculture Truax at Wooster, Ohio, in July, was attended by Prof. H. A. Gossard, J. S. Houser, L. L. Huber, C. R. Neiswander and C. R. Cutright of the Station staff, Mr. Fall representing the Federal Department, Mr. Faxon for the State Bureau of Plant Industry, and Herbert Osborn for the Extension Department of the State University as entomologists: officers of the Board of Agriculture and Experiment Station were also present. A number of matters of policy relating to control measures for the corn borer were discussed and definite agreement reached on a number of points.

A conference of entomologists and others interested in chinch bug control in the southwestern winter wheat territory was held in the office of the Southwestern Wheat Improvement Association at Kansas City, Mo., October 29. The following entomologists were present: T. B. Gordon, Oklahoma State Board of Agriculture; C. E. Sanborn, Oklahoma Experiment Station; M. H. Swenk, University of Nebraska; Otis Wade, Extension Entomologist of Missouri; E. G. Kelly, Extension Entomologist of Kansas; J. W. McColloch, Kansas State Agricultural College and S. J. Hunter, Kansas University. Plans were prepared and endorsed by all present for an unified campaign of winter burning to control the chinch bug in Oklahoma, Kansas, Missouri and Nebraska.

An initial meeting of the entomologists of Indiana was held at Purdue University, Lafayette, Indiana, October 26. The purpose of this conference was to enable the men throughout the State interested in entomology to become better acquainted with one another and with the problems with which each is dealing that they might better cooperate and be of mutual assistance, and also, so far as possible, to promote the entomological interests within the State. Those participating in the conference included the following: W. S. Blatchley, E. B. Williamson, A. C. Kinsey, F. N. Wallace, H. F. Dietz, B. E. Montgomery, W. H. Larrimer, W. B. Noble, H. R. Painter, B. A. Porter, J. Troop, W. A. Price, C. R. Cleveland, G. M. Stirrett, H. E. Enders and J. J. Davis. J. G. Sanders was a visitor.

According to *Science*, the 91st meeting of the Pacific Coast Entomological Society was held at the University of Southern California, Los Angeles, September 11. Dr. J. A. Comstock was elected chairman and H. E. Burke secretary. The following members and guests were present: A. J. Basinger, H. E. Burke, R. E. Campbell, J. A. Comstock, F. R. Cole, H. S. Fawcett, C. K. Fisher, R. D. Hartman, Trevor Kincaid, A. O. Larson, Isabel McCracken, H. S. Smith, H. E. Summers, E. P. Van Duzee, Mr. and Mrs. W. H. Volck, Mr. and Mrs. W. S. Wright, Mr. Osterhout. The following papers were presented: "Problems of the Amateur Entomologist" by W. S. Wright; "Entomology at the California Academy of Sciences" by E. P. Van Duzee; "Curious Diptera from the Philippines and Adjacent Regions" by F. R. Cole; "The Alder Sawfly," "The European Earwig" by Trevor Kincaid; "The Rediscovery of a Lost Species" by J. A. Comstock.

According to *Science*, a permanent organization to be known as the National Bollweevil Control Association was created on October 26, marking the end of the bollweevil menace conference at New Orleans. The association will be perfected by an executive committee of twenty-two members, representing the varied interests

of the cotton industry. Claude G. Rives, Jr., of New Orleans, president of the Louisiana Bankers' Association, chairman of the conference, named part of this committee, which will meet on November 17 in New Orleans, when the full personnel will have been named. Those already named on the committee include: from the Department of Agriculture, W. D. Hunter and B. R. Coad, who is in charge of the Federal bollweevil experimental station at Tallulah, La.; from the Association of Southern Agricultural Workers, W. E. Hinds, of the Alabama Polytechnic Institute, and D. C. Hull.

The following resignations from the Bureau of Entomology have been announced: L. M. Bertolf, assistant bacteriologist, bee culture investigations, to become instructor of biology, North Carolina College for Women, Greensboro, N. C.; L. L. Benton, W. C. Gideon, J. G. Lewis, G. E. Hawkins, K. M. Mace, C. A. Bolt, W. H. Craven, J. H. Hunter, C. Ling, L. C. McCraw, A. L. McCrary, W. D. McGowan, F. G. Martin, M. C. Martin, R. L. Martin, D. L. Outen, S. D. Reid, T. D. Rictenbaker, T. S. Smith, J. N. Todd, A. M. Bacot, E. B. Barnett, G. R. Fulton, L. F. Greer, S. B. Hendricks, L. P. Hodges, B. C. House, D. E. Lott, T. E. McNeel, A. L. Monroe, R. W. Necaise, S. Sevier, of the bollweevil force; L. L. English, Mexican bean beetle, to become a graduate assistant at the Iowa Agricultural College, where he will investigate insecticides and work for the doctorate; Dr. Arnold P. Sturtevant, bee disease work, to accept a position in the bacteriological department of the New York Homeopathic Medical College; W. D. Mecum, field assistant, Madison, Wis.; C. H. Hadley, Riverton, N. J., to become Director, Bureau of Plant Industry, Harrisburg, Pa.

Notes On Apiculture

The fall meeting of the Connecticut Beekeepers' Association was held at the State Capitol, Hartford, October 20.

The annual meeting of the Indiana State Beekeepers' Association will be held at Indianapolis on Thursday and Friday, December 13 and 14. Mr. C. O. Yost, State House, Indianapolis, is the Secretary.

Mr. Wallace Park has resigned his research work in apiculture at the Iowa Agricultural Experiment Station to take charge of the beekeeping work in the department of entomology at the University of Illinois.

The annual convention of the New Jersey Beekeepers' Association will be held on January 17 and 18 at Trenton, in connection with Agricultural Week activities. Mr. Jay Smith of Vincennes, Ind., has been engaged as one of the speakers.

A beekeepers' conference was held Thursday, November 8, at the Eastern Apple Exposition and Fruit Show at the Grand Central Palace, New York City. Some of the speakers were Dr. E. F. Phillips, Prof. E. N. Cory, George H. Rea and E. R. Root.

Dr. Robert Burri, whose work on the brood diseases of bees is well known and who is now director of the Dairy Experimental Station at Liebefeld, Switzerland, was in Washington during the International Dairy Conference. He reports that the work on the control of the Isle of Wight disease in Switzerland is progressing favorably.

Mr. R. L. Parker of the Department of Entomology has been transferred to take charge of the research work in Apiculture of the Iowa Experiment Station, succeeding Wallace Park who has gone to the Department of Entomology at the University of Illinois. Mr. Parker is at present working on his Doctor's Degree in Apiculture, having already received his Master's Degree in Apiculture, so that he comes to the

work thoroughly trained to follow the researches which have been started in the Agricultural Experiment Station.

Dr. E. F. Phillips will attend a series of meetings in South Dakota, North Dakota, Montana, Wyoming, Colorado and Nebraska between November 20 and December 6, the schedule having been arranged through the American Honey Producers' League committee on meetings of which Mr. Russell H. Kelty is chairman.

In connection with the Eastern Apple Show and Fruit Exposition held at the Grand Central Palace, New York City, November 3rd to 8th, there were extensive exhibits of honey. Thursday, November 8th, was "Honey Day" and on that day meetings were held which were well attended by beekeepers of the adjoining states and at which the uses of honey and its marketing were discussed. The meetings were held under the direction of R. B. Willson, Extension Specialist for New York State.

A short course in beekeeping will be held at Purdue University, Lafayette, Indiana, February 11th to 14th.

The "bee louse," *Braula coeca*, a well-known visitant of the bee colony in almost all parts of the world, has been repeatedly imported into the United States on queen bees from foreign countries and as a rule has disappeared promptly after the introduction of the imported queens into full colonies. As a result American beekeepers have believed that this species could not become established in this country. Several years ago it was reported that this species occurs in Carroll County, Md., and another report has been received from an apiary in central Pennsylvania. E. L. Sechrist recently visited Carroll County and found this species in the apiaries of one firm of beekeepers, and it probably occurs to a limited extent elsewhere in the locality. No damage seems to occur in strong, healthy colonies of bees. It is especially noted that if a colony of black bees containing Braula is queenless for a time, when an Italian queen is introduced, she is immediately covered with large numbers of Braula, and the beekeepers claim that in such cases the young Italian queen soon comes to look like and behave like an old worn-out queen. Material was collected and brought to Washington in which many adults and also eggs and pupae were found. Developmental stages were found to occur in tunnels under the capping of sealed honey. Until recently Braula has been supposed to be similar in its mode of development to the sheep tick, which develops to the pupal stage inside the parent. Since Braula deposits eggs, it can not belong to the same series of Diptera as the sheep tick. With the material now at hand it should be possible to establish the relations of this interesting insect to other Diptera.

Horticultural Inspection Notes

Mr. Perry A. Glick, formerly Assistant Entomologist of Arizona, has been appointed as Plant Quarantine Inspector to assist in the enforcement of the Fruit and Vegetable Quarantine, No. 56, at the port of New York.

Mr. L. R. Warner, who is in charge of the activities of the Florida Plant Board at Key West, recently visited Washington for the purpose of conference with officials of the Federal Horticultural Board.

Dr. W. A. Orton visited Cuba in November for the purpose of studying the potato situation, and incidentally looking into the possibilities of fruit flies infesting fruits which may be offered for entry into the United States.

Mr. Robert L. Trigg, a graduate of the Mississippi A. & M. College, who during

the summer months was engaged at Gainesville, Florida, in work for the National Research Council, was appointed Plant Quarantine Inspector October 1, 1923 with assignment in New York.

Mr. H. W. Lamp, an inspector of the Federal Horticultural Board, located in El Paso, Texas, was in Washington during the month of October assisting in the inspection and certification of plants introduced under special permit.

Mr. Harry B. Shaw visited Washington during the month of October for the purpose of conference to determine methods to be employed in enforcing the Fruit and Vegetable Quarantine, No. 56, which became effective November 1, 1923. Mr. Shaw is in charge of the work of the Federal Horticultural Board in New York City.

Mr. O. D. Deputy, Chief Inspector of the Mexican Border Service, visited Laredo, Texas during the month of October for the purpose of perfecting the present method of distributing the gas from the generators throughout the car fumigation units.

Mr. F. A. Johnston, an inspector of the Federal Horticultural Board, stationed in Washington, D. C., visited St. Louis, Missouri in September for the purpose of examining a shipment of orchids from Colombia.

Contraband cotton lint and seed continue to arrive at various ports of entry. Messrs. Kisliuk and Cogswell intercepted, in September at Philadelphia, five pounds of raw cotton containing over one hundred seeds in a passenger's trunk, arriving from Italy. The cotton originated in Dalmatia. Cotton samples from India were in a number of instances found to contain cotton seed. Mr. Kisliuk also collected cotton seed in an egg-case containing oranges and orange leaves which arrived from Argentina.

The European Earwig has been intercepted on several occasions in boxes arriving in Washington containing material imported under special permit. These shipments were received from Holland and England.

Agriotes lineatus Linn., a wireworm which is reported to be common in Europe in fields and meadows, was collected about the roots of Amaryllis arriving from Germany, by Mr. R. G. Cogswell. Apparently this injurious wireworm is not established in the United States.

The Avocado Weevil, *Heilipus lauri* Boh., was intercepted on two occasions during the month of June by the inspectors of the Federal Horticultural Board, located in Eagle Pass, Texas; and the Mexican Fruit Fly was collected by Mr. T. A. Arnold in oranges arriving from the interior of Mexico at El Paso.

An egg mass of the Gipsy Moth was taken in apple stock arriving in the foreign mail at Philadelphia, by Mr. Chester A. Davis in October. Interceptions of this type illustrate the importance of close cooperation on the part of the Postal Officials and those engaged in the inspection of foreign plant material.

The week ending October 6 was a busy one for the inspectors of the Federal Horticultural Board located in Boston. During that period, 59 interceptions of contraband were made in passengers' baggage. In addition, 486 individual plants, 9 bundles of mixed plants, 3 bushels of sweet potatoes, ½ peck of corn on the cob, and a number of Irish potatoes were intercepted in the course of ship inspection.

Medical Entomology

The unusually early appearance of *Hypoderma lineatum* in the subdermal tissue in the backs of cattle in Texas is noteworthy. In certain sections of the plateau region the larvea were fully developed about the middle of August. In the vicinity of Dallas the appearance of larvae in the backs of cattle is about one month earlier than normal, considerable numbers being present during the latter part of September. Under favorable weather conditions it is almost certain that a rather large emergence of the adults of this insect will take place during the fall and early winter months.

Dengue fever has been reported from the southern states from Georgia westward. The first case reported for Georgia was in the week ending October 12 and no cases have been reported from Florida. It is noteworthy that although the disease appeared rather early during the summer it did not gain great headway. This might be explained partially by the large percentage of immunes following last years epidemic and partially by the relatively smaller numbers of the yellow fever mosquitoes. This mosquito has been noticeably less abundant in Dallas than it was last year though this may not be the case throughout the South.

The following is the number of cases of dengue given in the "Public Health Reports" up to and including the week ending October 26:

Georgia	8
Alabama	35
Arkansas	6
Louisiana	259
Texas	422

According to *Science*, the Widow of the late Surgeon General William C. Gorgas is collaborating with Burton J. Hendrick, author of "The Life and Letters of Walter H. Page," in preparing a biography of General Gorgas, which, it is hoped, may be published during the coming year.

According to *Science*, The London School of Tropical Medicine has arranged to send an expedition to Samoa to study the prevention of elephantiasis and filariasis, diseases which affect 85 per cent. of the inhabitants of the Samoan group. The expedition will have its headquarters at Apia and will be away for two years; it will work in cooperation with the New Zealand government, which is responsible for the administration of Samoa. The expedition, which will leave England on November 15, will be under the leadership of Dr. Patrick Buxton, who did valuable work on entomology in Mesopotamia during the war, and has recently been entomologist to the Palestine Government at Jerusalem.

ERRATA

The illustrations on plate 4 are printed upside down, consequently the directions in relation to figures 3 and 4 in the explanation of the plate are the reverse of correct.

INDEX

Thirty-sixth Annual Meeting of the American Association of Economic Entomologists
Cincinnati, Ohio

December 29, 1923 to January 2, 1924

THIRTY-SIXTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, CINCINNATI, OHIO,

DECEMBER 29, 1923 TO JANUARY 2, 1924

The 36th annual meeting of the American Association of Economic Entomologists will be held at Cincinnati, Ohio, December 29, 1923, to January 2, 1924.

The meeting of the Sections of Apiculture and Horticultural Inspection will be held on Saturday, December 29, prior to the opening session of the general association. The opening business session of the association will be held Monday morning, December 31, at which time the address of the President will be delivered. Meetings will continue on Tuesday and Wednesday.

Sectional Meetings

The meeting of the Section of Apiculture will be held at 10 a. m., Saturday, December 29, in Room 11, McMicken Hall.

The Section of Horticultural Inspection will meet at 1.30 p. m., Saturday, December 29, in Room 11, McMicken Hall.

Other Meetings

The annual meeting of the American Association for the Advancement of Science and many of its sections and affiliated societies will be held December 27, 1923, to January 2, 1924.

The Sigma Xi dinner will be held at 6.45 p. m., December 28.

A demonstration lecture on "The Vacuum; There's something in it" will be given by Dr. Willis Rodney Whitney at 8.45 p. m., December 28 in the Hughes High School Auditorium.

The Entomological Society of America will open its meeting on Thursday, December 27, and continue its sessions on Friday and Saturday.

Entomologists interested in the Insect Pest Survey and in extension work will meet at 8 p. m., Monday, December 31. Members of this association interested in medical entomology will meet in joint session with members of Section N. The exact place of meeting will be announced later.

The Committee on Policy will meet at 6.30 p. m., Saturday, December 29, at Hotel Gibson.

Hotel Headquarters

Hotel headquarters for this association will be at the Hotel Gibson where rates have been secured ranging from $2.50 to $8.00 for single rooms and $4.00 to $10.00 for double rooms. All rooms are provided with bath. Members are requested to engage rooms promptly.

Railroad Rates

Reduced rates will be secured from some of the railroads. Members should obtain exact information prior to the time of the meeting from their local railroad agent or from Dr. Burton E. Livingston, Permanent Secretary, American Association for the Advancement of Science, Smithsonian Institution, Washington, D. C.

Dinner

The entomologists dinner will be held on Tuesday evening, January 1, at 7 p. m.

Membership

Applications for membership can be secured from the Secretary or from the Committee on Membership. These should be filled out, properly endorsed, and filed with the Membership Committee on or before December 29. Every application must be accompanied with a fee of $3.50 to cover dues and subscription to the JOURNAL for the year following election.

Program

SECTION OF APICULTURE

S. B. FRACKER, *Chairman* G. M. BENTLEY, *Secretary*

Saturday morning session, December 29, 10 a. m., Room 11, McMicken Hall

Address of the Chairman, S. B. Fracker, Madison, Wisconsin.

READING OF PAPERS AND DISCUSSIONS

1. Methods of Teaching Beekeeping—Symposium.
   - A. Content of the Elementary Course. (10 minutes). J. S. Hine, Columbus, Ohio.
   - B. Laboratory Methods. (10 min.) G. M. Bentley, Knoxville, Tenn.

C. Methods of Handling a Winter Short Course. (10 min.) H. F. Wilson, Madison, Wis.

D. Research Problems Adapted for Graduate Students. (10 min.) F. B. Paddock, Ames, Iowa.

E. Other Preparation Needed by Those Majoring in Beekeeping. (10 min.) F. E. Millen, Guelph, Canada.

2. The Honey Bee as an Agent in the Pollination of Apples, Pears and Cranberries. (10 min.) Ray Hutson, New Brunswick, N. J.

3. Seasonal Variation in Brood Population. (10 min.) W. J. Nolan, Washington, D. C.

4. Notes on Fall Feeding. (15 min.) F. B. Paddock, Ames, Iowa.

5. The Relation of Stores to Brood Rearing. (10 min.) J. H. Merrill, Manhattan, Kan.

6. The Storing and Ripening of Honey by Honeybees. (10 min.) (Lantern.) Wallace Park, Urbana, Ill.

7. Temperature Changes in the Hive During a Honey-flow. (10 min.) J. I. Hambleton, Washington, D. C.

8. Spreading Foulbrood by Un-intelligent Treatment. (10 min.) E. R. Root, Medina, Ohio.

9. The Relation of Bacillus Alvei to Confusing Symptoms in European Foulbrood. (10 min.) A. P. Sturtevant, Washington, D. C.

10. The Status of Isle of Wight Disease in Various Countries. (10 min.) E. F. Phillips, Washington, D. C.

Report of Committees.

Selection of Officers.

Adjournment.

Program

SECTION OF HORTICULTURAL INSPECTION

P. A. GLENN, *Chairman* E. R. SASSCER, *Secretary*.

Saturday Afternoon session, December 29, 1.30 p. m.; Room 11, McMicken Hall

Address by the Chairman, P. A. Glenn, Urbana, Illinois.

READING OF PAPERS AND DISCUSSIONS

1. Motion Picture—"Halting Foreign Plant Foes."

2. Recent Work of the Federal Horticultural Board. C. L. Marlatt.

3. Horticultural Inspection Methods in California. Lee A. Strong.

4. The Fight Against the Gipsy Moth in New Jersey. T. J. Headlee, New Brunswick, N. J.

5. Status of Hydrocyanic Acid Gas Treatment of Nursery Stock. J. J. Davis, LaFayette, Ind.

6. Important Foreign Insect Pests Collected on Imported Nursery Stock in 1923. E. R. Sasscer.

7. American Plant Production under Quarantine 37. R. Kent Beattie, Washington, D. C.

Reports of Committees.

Selection of Officers.

Adjournment.

Program

American Association of Economic Entomolggists

Monday morning, December 31, 10 a. m.; Chemistry Auditorium.

Report of the Secretary.

Report of Subscription Agent, by C. W. Collins, Melrose Highlands, Mass.

Report of the Executive Committee, by President A. G. Ruggles.

Report of the Delegate Appointed to Attend the International Conference of Phytopathology and Economic Entomology at Wageningen, Holland, by L. O. Howard, Washington, D. C.

Report of the Representative to the National Research Council, by George A. Dean, Manhattan, Kansas.

Report of the Committee on Policy, by P. J. Parrott, Geneva, N. Y.

Report of the Trustees of the Crop Protection Institute, by W. C. O'Kane, Durham, N. H.

Report of the Representatives on the Council of the Union of American Biological Societies, by A. L. Quaintance, Washington, D. C.

Report of the Committee on Nomenclature, by Edith M. Patch, Orono, Me.

Report of the Committee on Index to Economic Entomology, by E. P. Felt, Albany, N. Y.

Report of the Committee on United States National Museum, by J. J. Davis, Lafayette, Ind.

Report of the Committee on Amendments to the Constitution and By-Laws, by W. P. Flint, Urbana, Ill.

Appointment of Committees.

Miscellaneous Business.

New Business.

Annual Address of the President, A. G. Ruggles, St. Paul, Minnesota.

1. "Pioneering in Economic Entomology."

READING OF PAPERS

2. The Insects Infesting Animal Products in the United States. (10 min.) Perez Simmons, Silver Spring, Md.

3. Further Observations on Tabanidae (Horseflies) in Louisiana. (10 min.) T. H. Jones and W. G. Bradley, Baton Rouge, La.
Adjournment.

Program

Monday Afternoon Session, December 31, 1923, 1:30 p. m.; Chemistry Auditorium

Discussion of the Presidential Address.

READING OF PAPERS

4. The Occurrence of the European Tortricid, *Cacoecia rosana* L. in Canada. (10 min.) Arthur Gibson, Ottawa, Canada.

This European insect has of recent years developed into a pest of importance in several sections of Canada.

5. Factors Affecting Damage to Crops by Insects. (10 min.) (Lantern). R. L. Webster, Fargo, N. D.

A brief statement concerning limiting factors to crop production and their relation to insect injury, with particular reference to deficient rainfall.

6. Temperature as a Limiting Factor in the Life of Subcortical Insects. (15 min.) S. A. Graham, St. Paul, Minn.

7. The Australian Prickly-pear Problem. (15 min.) (Lantern.) J. C. Hamlin, Houston, Texas.

An attempt biologically to control the prickly-pear pest.

8. The Gipsy Moth Problem in New York State. (12 min.) (Lantern.) E. P. Felt, Albany, N. Y.

9. Recent European Investigations of the Parasites of the Gipsy Moth and the Brown-tail Moth. (15 min.) S. S. Crossman and R. T. Webber, Melrose Highlands, Mass.

An account of recent introductions into the United States of parasites of the Gipsy Moth and Brown-tail Moth.

10. The Importation of Parasites to control the Japanese Beetle (*Popillia japonica*). (10 min.) (Lantern). L. B. Smith, Riverton, N. J.

A general summary of the work accomplished and results secured during past season.

11. Selective Parasitism by *Tiphia* sp. (8 min.) H. A. Jaynes and T. R. Gardner, Riverton, N. J.

The result of three years study of the parasitism on *Ochrosidia* (*Cyclocephala*) *immaculata* and *Popillia japonica*, by certain species of Tiphia.

12. Notes on the Life History of a Beneficial Reduviid, *Sinea diadema* (Fabr.). (5 min.) (Lantern). P. A. Readio, Lawrence, Kan.

13. Natural Enemies of Beet Leafhopper (*Eutettix tenella* Baker). Henry H. P. Severin, Berkeley, Calif.

14. Dusting Investigations on Truck Crops in Maryland. (15 min.) (Lantern). E. N. Cory and S. F. Potts, College Park, Md.

A summary of two years work with nicotine dusts on the pea aphis with special reference to the effectiveness of commercial and home mixed dusts, rates per acre and comparison of costs. Summaries of results with other dust mixtures used against the pea aphis.

15. Some Chemicals Attractive to Adults of the Onion Maggot, *Hylemyia antiqua* Meig. and the Seed-Corn Maggot (*Hylemyia cilicrura* Rond.). (15 min.) (Lantern). Alvah Peterson, New Brunswick, N. J.

Several alcohols and other organic chemicals attract males and female flies.

16. Some new aspects of the Bichloride Treatment for Cabbage Maggot Control. (10 min.) Hugh Glasgow, Geneva, N. Y.

Observations on the influence of mercuric chloride on plant growth, and on the development of certain diseases affecting cabbage seedlings.

17. A Stilt-bug, *Jalysus spinosus* Say, Destructive to the Tomato. (10 min.) C. R. Phipps, Mountain Grove, Mo.

Description, injury, life-cycle and control.

Adjournment.

Monday Evening Session, December 31, 1923, 8:00 p. m.; Chemistry Auditorium

MEETING OF THE INSECT PEST SURVEY AND EXTENSION ENTOMOLOGISTS

Program

Tuesday Morning Session, January 1, 1924, 10:00 a. m.; Chemistry Auditorium

18. Methods of Estimating Insect Abundance and Damage. Symposium. (10 minutes each).

Statistical Work in Entomology. J. A. Hyslop, Washington, D. C.

The Use of Biometrical Methods in the Interpretation of Codling Moth Experiments. F. Z. Hartzell, Fredonia, N. Y.

Methods of Estimating Insect Abundance and Damage.
The Gipsy Moth. A. F. Burgess, Melrose Highlands, Mass.
The San Jose Scale. J. J. Davis, Lafayette, Ind.
The Boll Weevil. W. D. Hunter, Houston, Texas.
Grasshoppers. Stewart Lockwood, Billings, Mont.
The Hessian Fly. W. H. Larrimer, West Lafayette, Ind.

Value of Statistical Methods in Entomology. C. L. Marlatt, Washington, D. C.

Reading of Papers and Discussions

19. Recent Developments in Greenhouse Fumigation with Hydrocyanic Acid Gas. (10 min.) (Lantern). E. R. Sasscer and C. A. Weigel, Washington, D. C.

Device for dropping cyanid in jars simultaneously in commercial houses. Value of liquefied hyrdocyanic acid gas. Preliminary notes on calcium cyanid. Plant tolerance.

20. Lubricating Oil Emulsion as a Control for *Chrysomphalus aonidum* in Greenhouses. (10 min.) C. A. Weigel and Miss B. M. Broadbent, Washington, D. C.

Results of recent experiments in controlling *Chrysomphalus aonidum* on Kentia palms, Ficus, and other ornamental plants.

21. The Use of Lubricating Oil Emulsions on Greenhouse Scale Insects. (5 min.) C. C. Compton, Aurora, Ill.

22. Oil sprays for the Control of the Winter Eggs of *Paratetranychus pilosus*. (15 min.) (Lantern). C. C. Hamilton, College Park, Md.

23. Four Year Experiments on the Control of the Red Spider (*Paratetranychus pilosus*. (10 min.) S. W. Frost, Arendtsville, Pa.

Dormant and Summer applications with dusts and sprays for the control of Red Spider.

Adjournment.

Program

Tuesday Afternoon Session, January 1, 1924, 1:30 p. m.; Chemistry Auditorium

READING OF PAPERS

24. Control of the Root-Knot Nematode. (15 min.) J. R. Watson, Gainesville, Fla.

25. The Use of Calcium Cyanide Against Fleas and Other Injurious Insect Pests. (10 min.) K. C. Sullivan, Columbia, Mo.

A brief summary of experiments which have been conducted during the past season with calcium cyanide on the control of fleas and melon pests; also some brief notes on its use for fumigating greenhouses and nursery stock.

26. Calcium Cyanide. (10 min.) William Moore, New York, N. Y.

The manufacture, chemical composition and the reactions which makes this compound a promising insecticide.

27. Soil Insecticide Investigations at the Japanese Beetle Laboratory during 1923. (5 min.) B. R. Leach, W. E. Fleming and J. P. Johnson, Riverton, N. J.

28. Insecticidal Properties of Some Sulfur Compounds. (10 min.) Albert Hartzell and F. H. Lathrop, Geneva, N. Y.

The methods of preparation of a Carbon Disulfide Emulsion and its possibilities as a contact insecticide.

29. The Price of Insecticides. (10 min.) V. I. Safro, Clarksville, Tenn.

Elementary economic factors almost universally lost sight of by entomologists in the search for cheaper insecticides.

30. The Japanese Beetle Status in 1923. (10 min.) L. B. Smith. Riverton, N. J.

General summary of spread and results of investigations on the control of this insect in 1923.

31. Some Recent Developments in the Use of Paradichlorobenzene. (10 min.) S. C. Chandler, Carbondale, Ill.

32. Three Years of Paradichlorobenzene Experiments in the South. (10 min.) O. I. Snapp, Fort Valley, Ga.

33. Carbon disulphid for exterminating the Round-headed Apple-tree borer (*Saperda candida*). (10 min.) O. A. Johannsen, Ithaca, N. Y.

The proposed method requires less time than when using the knife; neither mutilates nor injures the tree, andwhen properly used, is 100% efficient.

34. Notes on the Occurrence of the Oriental Fruit Moth (*Laspeyresia molesta*) in Southeastern Pennsylvania in 1923. (3 min.) T. L. Guyton, Harrisburg, Pa.

The appearance of *Laspeyresia molesta* in alarming numbers occurred over the southeastern corner of Pennsylvania. No injury was noticed in this area in 1922.

35. A New Fruit Pest. (10 min.) (Lantern). W. P. Flint, Urbana, Ill.

During the past 3 seasons, apples and peaches in Illinois have been injured by a beetle previously of rare occurrence in the State and not known to feed upon fruit. A brief summary of the character of injury and feeding habits of this beetle.

36. Control of Leaf Hoppers (*Empoa rosae* L.) in bearing orchards. (10 min.) (Lantern). S. W. Frost and E. M. Craighead, Arendtsville, Pa.

A new type of injury to apple by hoppers; control experiments in bearing orchards.

37. Should the July Apple Spray as given in Ohio be timed for the Second Brood only of Codling Worms? (5 min.) (Lantern). H. A. Gossard, Wooster, Ohio.

Relation between the life history of codling worms and time of spraying graphically shown. The chart shows that in Ohio the July spray is given for the first brood as well as the second.

38. A Side Light on Spray Injury to Apple Fruits. (5 min.) (Lantern). P. J. Parrott, Geneva, N. Y.

During recent years there has been growing interest with respect to the effect of spray materials on the quality and size of apple yields. In this paper data are presented relative to the occurrence of "spray burn" following applications of various dust and spray mixtures.

39. Spreader Tests on Apples and Peaches: A Second Report. (8 min.) L. A. Stearns and W. S. Hough, Blacksburg, Va.

Title indicates contents of paper; report covering a second seasons' investigation of casein spreader in orchard practice.

40. The Estimation of Dosage for Contact Dusts. (10 min.) F. Z. Hartzell, Fredonia, N. Y.

41. Spraying Experiments for the Control of the San Jose and other Scales. (10 min.) J. J. Davis, Lafayette, Ind.

Summary of experiments for three years testing dry and liquid lime-sulphur, miscible oils and lubricating oil emulsion for the control of the San Jose, Cottony Maple and Oyster Shell Scales.

42. Further Studies in Prune Root Borer Control in Oregon. (10 min.) F. H. Lathrop and V. M. Trask, Highland, N. Y.

Results of naphthalene whitewash applications and of "P. D. B." treatments.

43 Control measures for the cornfield ant (*Lasius niger americanus*) in Strawberry Beds. A Preliminary Report. (5 min.) W. J. Baerg, Fayetteville, Ark.

The paper is a brief description of the injury caused by the cornfield ant to strawberry plants and a report of the results obtained from the use of various insecticides.

44. The Houghton Gooseberry Aphis, *Myzus houghtonensis* Troop, as a Pest in Ohio. (5 min.) (Lantern). D. M. DeLong and A. A. Mathewson, Columbus, Ohio.

Notes on the life history and economic importance.

Adjournment.

Tuesday Evening Session, January 1, 1924, 7 p. m.

Entomologists Dinner.

Program

Wednesday Morning Session, January 2, 1924, 10:00 a. m.; Chemistry Auditorium

Reading of Papers

45. Certain Dusts as Agents for the Protection of Stored Seeds from Insect Infestation. (15 min.) T. J. Headlee, New Brunswick, N. J.

46. Notes on the Use of Chlorine Gas as an Insecticide. (3 min.) T. L. Guyton, Harrisburg, Pa.

Chlorine Gas was used in an attempt to control *Sitotroga cerealella*. The gas was found to be an imperfect insecticide and to reduce the germination about three-fourths.

Papers on European Corn Borer

47. Research Projects and a Synopsis of Results. (8 min.) D. J. Caffrey, Arlington, Mass.

48. Environmental Studies. (8 min.) K. W. Babcock, Arlington, Mass.

49. Parasite Introductions. (8 min.) D. W. Jones, Arlington, Mass.

50. European Corn Borer Investigations in Ohio. (8 min.) L. L. Huber, Wooster, Ohio.

51. European Corn Borer: Control Measures Recommended in the Province of Ontario. (8 min.) Lawson Caesar, Guelph, Ontario, Canada.

52. Plowing as a Factor in Control. (8 min.) H. G. Crawford, Ottawa, Canada.

53. The European Corn Borer: Clean-up Measures. (8 min.) (Lantern). T. H. Parks, Columbus, Ohio.

54. Quarantines in Canada. (8 min.) L. S. McLaine, Ottawa, Canada.

55. European Corn Borer Quarantine (8 min.) L. H. Worthley, Arlington, Mass.

Adjournment.

Program

Wednesday Afternoon Session, January 2, 1924, 1:30 p.m.; Chemistry Auditorium

Reading of Papers

56. An Asiatic Beetle in Connecticut. *Anomala orientalis* Waterhouse. (10 min.) W, E. Britton, New Haven, Conn.

Specimens of *Anomala* collected in a nursery in New Haven in 1920 and 1921 were identified in May 1922, as *Anomala orientalis*. In 1923, white grubs injured the roots of grass in lawns in the vicinity. Adults were reared and proved to be this species.

57. The biology of *Anomala kansana*. (15 min.) W. P. Hayes and J. W. McColloch, Manhattan, Kan.

The life history, length of stages and importance of this new species is discussed.

58. Grasshopper Baits: With Special Reference to Sodium Arsenite. (12 min.) C. L. Corkins, Laramie, Wyo.

This paper will be a brief of the results of three years experimentation in Colorado.

59. The Time of Planting Corn as a Factor in Corn Earworm Control (10 min.) J. W. McColloch Manhattan, Kan.

60. Importance of the Flax-seed count in determining the Hessian fly free date. (5 min.) C. J. Drake, F. A. Fenton and F. G. Butcher, Ames, Iowa.

61. *Caenurgia erechtea* Cram. (Noctuidae) as an Alfalfa Pest. (7 min.) (Lantern). R. C. Smith, Manhattan, Kan.

One of the lesser alfalfa pests but often abundant in Kansas. The paper is a summary of life history and field observations with description of stages and one plate.

62. New Developments in Alfalfa Weevil Activity and Control. (15 min.) Claude Wakeland, Prama, Idaho.

63. Controlling Chinch Bugs in Missouri with Calcium Cyanide. (15 min.) Leonard Haseman and S. W. Bromley, Columbia, Mo.

Short paper dealing with the methods of controlling chinch bugs with Calcium Cyanide in both an experimental and practical way. Calcium cyanide was successfully used on a rather large scale in Missouri during the past season and it is the intention of this paper to explain briefly its use and the results obtained.

Final Business

Report of Committee on Resolutions.

Report of Committee on Membership.

Reports of other committees.

Nomination of Journal officers by advisory committee.

Report of Committee on Nominations.

Election of Officers.

Miscellaneous business.

Fixing the time and place of next meeting.

Final adjournment.

A. G. Ruggles, *President*,
St. Paul, Minn.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

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